American Psychological Asso
Psychological monographs :
R.W.B. JACKSON LIBRARY
OISE CIR
3 0005 03033 2806

PSYCHOLOGICAL REVIEW PUBLICATIONS
WHOLE NO. 214
1936

Psychological Monographs

EDITED BY

JOHN F. DASHIELL, UNIVERSITY OF NORTH CAROLINA

S. W. FERNBERGER, UNIVERSITY OF PENNSYLVANIA *(J. Exper. Psychol.)*
W. S. HUNTER, BROWN UNIVERSITY *(Psychol. Index)*
H. S. LANGFELD, PRINCETON UNIVERSITY *(Psychol. Rev.)*
JOHN A. McGEOCH, WESLEYAN UNIVERSITY *(Psychol. Bull.)*

STUDIES IN GENERAL PSYCHOLOGY

Volume II

EDITED BY

CHRISTIAN A. RUCKMICK

UNIVERSITY OF IOWA STUDIES IN PSYCHOLOGY

CHRISTIAN A. RUCKMICK, EDITOR

No. XX

PUBLISHED FOR THE AMERICAN PSYCHOLOGICAL ASSOCIATION BY
PSYCHOLOGICAL REVIEW COMPANY
PRINCETON, N. J.
AND ALBANY, N. Y.

Publications of the American Psychological Association

EDITED BY

S. W. FERNBERGER, UNIVERSITY OF PENNSYLVANIA (*J. of Exp. Psych.*)
WALTER S. HUNTER, BROWN UNIVERSITY (*Abstracts*)
HENRY T. MOORE, SKIDMORE COLLEGE (*J. Abn. and Soc. Psychol.*)
HERBERT S. LANGFELD, PRINCETON UNIVERSITY (*Review*)
JOHN A. McGEOCH, WESLEYAN UNIVERSITY (*Bulletin*)
JOHN F. DASHIELL, UNIVERSITY OF NORTH CAROLINA (*Monographs*)

HERBERT S. LANGFELD, Business Editor

PSYCHOLOGICAL REVIEW

containing original contributions only, appears bi-monthly, January, March, May, July, September, and November, the six numbers comprising a volume of about 540 pages.

PSYCHOLOGICAL BULLETIN

containing critical reviews of books and articles, psychological news and notes, university notices, and announcements, appears monthly (10 numbers), the annual volume comprising about 720 pages. Special issues of the BULLETIN consist of general reviews of recent work in some department of psychology.

JOURNAL OF EXPERIMENTAL PSYCHOLOGY

containing original contributions of an experimental character, appears bi-monthly, February, April, June, August, October, and December, the six numbers comprising a volume of about 900 pages.

PSYCHOLOGICAL INDEX

(discontinued after No. 42, June, 1936)

is a compendious bibliography of books, monographs, and articles upon psychological and cognate topics that have appeared during the year. The INDEX has been published annually from 1895 to 1936, the volumes covering the literature of 1894 through 1935. Its bibliographical services will be carried on by the PSYCHOLOGICAL ABSTRACTS.

PSYCHOLOGICAL ABSTRACTS

appears monthly, the twelve numbers and an index supplement making a volume of about 700 pages. The journal is devoted to the publication of non-critical abstracts of the world's literature in psychology and closely related subjects.

PSYCHOLOGICAL MONOGRAPHS

consist of longer researches or treatises or collections of laboratory studies which it is important to publish promptly and as units. The price of single numbers varies according to their size. The MONOGRAPHS appear at irregular intervals and are gathered into volumes of about 500 pages.

JOURNAL OF ABNORMAL AND SOCIAL PSYCHOLOGY

appears quarterly, June, September, December, March, the four numbers comprising a volume of 448 pages. The journal contains original contributions in the field of abnormal and social psychology, reviews, notes and news.

ANNUAL SUBSCRIPTION RATES

Review: $5.50 (Foreign, $5.75).
Journal: $7.00 (Foreign, $7.25). **Monographs:** $6.00 per volume (Foreign, $6.30).
Bulletin: $6.00 (Foreign, $6.25). **Abstracts:** $6.00 (Foreign, $6.25).
Abnormal and Social: $5.00 (Foreign, $5.25). Single copies $1.50.
Current numbers: **Journal**, $1.25; **Review**, $1.00; **Abstracts**, 75c; **Bulletin**, 60c.

COMBINATION RATES

Review and Bulletin: $10.00 (Foreign, $10.50).
Review and J. Exp.: $11.00 (Foreign, $11.50).
Bulletin and J. Exp.: $12.00 (Foreign, $12.50).
Review, Bulletin, and J. Exp.: $16.00 (Foreign, $16.75).

Subscriptions, orders, and business communications should be sent to the

PSYCHOLOGICAL REVIEW COMPANY

PRINCETON, N. J.

VOL. XLVIII
No. 2
PSYCHOLOGICAL REVIEW PUBLICATIONS
WHOLE NO. 214
1936

Psychological Monographs

EDITED BY

JOHN F. DASHIELL, University of North Carolina

S. W. FERNBERGER, University of Pennsylvania *(J. Exper. Psychol.)*
W. S. HUNTER, Brown University *(Psychol. Index)*
H. S. LANGFELD, Princeton University *(Psychol. Rev.)*
JOHN A. McGEOCH, Wesleyan University *(Psychol. Bull.)*

STUDIES IN GENERAL PSYCHOLOGY

Volume II

EDITED BY
CHRISTIAN A. RUCKMICK

UNIVERSITY OF IOWA STUDIES IN PSYCHOLOGY

CHRISTIAN A. RUCKMICK, EDITOR

No. XX

Published for the American Psychological Association by
PSYCHOLOGICAL REVIEW COMPANY
PRINCETON, N. J.
and ALBANY, N. Y.

LIBRARY
JAN 7 1972
THE ONTARIO INSTITUTE
FOR STUDIES IN EDUCATION

INTRODUCTION

The studies which comprise this volume are concerned with the refinements of a widely used tool, commonly called the psychogalvanometric technique. It has been frequently applied to the psychogalvanic response (PGR), renamed by us the electrodermal response (EDR). These investigations continue the series presented in earlier volumes of the Iowa Studies as a program of research in the field of feeling and emotion. More than a score of publications within this area under the authorship of the editor and his students are included in this program.

Dr. Greenwald's dissertation investigated the pertinent problem concerning individual variations in the response to the continuous affective stimulation of motion-picture situations. In line with several investigations outside of this laboratory which have shifted the emphasis from the amount of deflection obtained to the pattern of the deflection, he has devised a new treatment of the data under the concept of the 'dermal response quotient.' He also found a more consistent variability in the female group than in the male group, a subject which will require further investigation. He discovered a close relation between the EDR and the conscious affective life as revealed by analytical verbal reports. In an earlier study, the technique was applied by Greenwald to abnormal individuals, furnished us through the excellent co-operation of the Psychopathic Hospital at the University. While he found no relationship between the EDR profiles and the groups of mental disorder, there were many indications in the manic-depressive group that the responses generally tallied with the stage of the disorder. In other cases clues were obtained in terms of the response to latent complexes in the individual's past history. Altogether, then, this technique furnishes us with a serviceable instrument in the treatment of otherwise refractory cases.

Miss Rasmus's study emerged from the reshowing technique used in previous studies, notably the investigation carried out by Dr. W. S. Dysinger. It rested on the assumption that much could be learned about affective and emotional responses by allowing them to degenerate, just as we get valuable information from a study of the gradual development of emotion as was done by Dembo. Both the verbal response and the EDR showed a decreasing effect of feeling with increased familiarity. This decrease was less evident in romantic scenes and scenes involving danger than in other types of episodes.

An irksome problem recognized in all work on the feelings and emotions involves the conflicting result from movements made during affective responses. It is well known that the EDR does not exclusively indicate feeling. Mr. Schaefer, therefore, concentrated on this difficulty and analyzed in detail the responses which are due to definite movements made with or without affective coloring. Since he was able to differentiate affective responses from motor responses, but not motor responses one from the other, a careful scrutiny of his data will reward all those interested in this somewhat perplexing subject.

The Editor's first obligations go to the students who so painstakingly revised their theses and put them into form for publication. He owes an especial debt of gratitude, however, to Mr. Buxton who not only aided in this process but also helped in critically editing the manuscripts for the press.

CHRISTIAN A. RUCKMICK

Iowa City, Iowa
15 April, 1936

CONTENTS

Introduction .... Christian A. Ruckmick... iii

Some Individual Differences in Electrodermal Response to Continuous Affective Stimulation .... D. Ulrich Greenwald...... 1

Electrodermal Responses of Abnormal Individuals .... D. Ulrich Greenwald...... 28

Degeneration of Emotional Responses upon Reshowing of Motion-Picture Situations.. Mildred H. Rasmus........ 40

The Effect of Movement on the Electrodermal Response .... Benjamin Schaefer 57

SOME INDIVIDUAL DIFFERENCES IN ELECTRODERMAL RESPONSE TO CONTINUOUS AFFECTIVE STIMULATION

by

D. Ulrich Greenwald

I. Introduction. The literature concerning electrodermal response has been summarized by *Landis* and *DeWick* (6) and *Landis* (7). A careful review of their summaries, however, together with a perusal of many of the original articles, reveals the fact that no one has directly investigated individual differences with respect to this response. The need for information in regard to basic physiological differences is imperative and the lack of it tends to invalidate much of the previous work. Especially is this true of studies which have assumed that individuals were physiologically uniform in the electrodermal response and that variations in obtained results were due entirely to differences in the effect of the stimulus upon mental functions.

It has been difficult in the past to obtain such data. It was necessary first to secure a large number of responses from each individual. Furthermore, the investigators generally used temporally discrete stimuli of a strongly affective tone. Because of the very discreteness of the stimuli and the fact that the period of indifference between them is relatively uncontrolled, such techniques were inadequate for a study of differences specific to the individual. Stimuli devised to arouse strong affective qualities tend to produce maximal electrodermal responses in all *O*s, with the result that they conceal responses of smaller magnitude. It is possible that these minor variations are as characteristic of the individual as the maximal ones which he exhibits when strongly stimulated.

Basic changes and improvements in technique were introduced by *Ruckmick*, who exercised greater temporal control over the experimental situation by using musical reproductions as stimuli. Later *Dysinger* and *Ruckmick* (2) utilized motion pictures to attain the same control. These investigators, however, studied electrodermal responses only in relation to specific points in the continuously changing situation. *Greenwald* (3) introduced the technique of recording all dermal changes during continuous stimulation. The technique was applicable for an interval of considerable length and a method was provided for the presentation of mild continuous stimuli during the desired period. For the first time individual differences in electrodermal response could be studied adequately.

We hoped, therefore, that the experiments reported here would aid us to discover differences due not necessarily to the arrangement of stimuli but to basic physiological and mental characteristics of the *O*s. A second purpose was to determine whether sex groups differed in this response and, if so, how greatly. Previous studies, *e.g.*, *Dysinger* and *Ruckmick* (2), *Porter* and *Copeland* (8), and *Wechsler, Crabb* and *Freeman* (11) have reported sex differences in electrodermal response, related to type of stimulus as well as to variations in age. The question of basic physiological differences, however, remained unsettled. We further wanted to determine which method of treating electrodermal response data was most reliable.

II. Method. The method, in brief, was to record all dermal changes in an adult *O* during a period of constant stimulation by motion pictures. On two days recordings were made during similar pictures for the purpose of validation. Twenty *O*s, 10 of each sex, were used.

In order to make a rigorous experimental attack, graduate students were selected to serve as *O*s. It was assumed that such *O*s would show a greater degree of affective maturity than a random adult population. The electrodermal response is usually a part of general bodily excitement which may accompany affective processes. Therefore if any real difference in this indicator appeared in such a mature group, it is probable that true differences would exist in an entire adult population.

Since we did not wish to investigate the response in its relation to the stimulus but merely the general character of the individual's responses, the motion picture situation with continuous recording of the electrodermal changes was used. Motion picture stimuli were chosen in preference to music because they were likely to invite maximal attention over longer periods of time.

The motion pictures selected as stimuli in aroused mild affective qualities in an adult group. They consisted of four reels of 'western cowboy' scenes so constructed that the first two reels formed a complete story and the second two a sequel to it. Although the films were of the older, silent type, they proved interesting enough to hold attention and yet not exciting enough to arouse any great degree of affectivity. Mild stimuli of this sort were chosen so that the variations in dermal activity would be moderate if they were due entirely to affective states. Thus any individual differences discovered should be of real significance. Conversely, however, no difference might have meant either that the stimulus was inadequate or that no individual differences existed.

Verbal reports were requested from all *O*s, since these reports are the only generally recognized criteria of affectivity and since the data concerning *O*'s experiences were valuable in interpreting his dermal responses. Furthermore, because of this activity, the *O*s took the experiment more seriously and gave better attention to the stimulus. It was necessary to train *O*s in a similar situation prior to the actual recording until they could report readily under experimental conditions.

III. Apparatus. In recording electrodermal changes, a form of the apparatus described by *Greenwald* (5) was used. The electrical circuit here used was identical, but the camera of *Wechsler's* psychogalvanograph was employed, with the Wheatstone bridge disconnected. This camera had been modified in our laboratory (3) to use cheaper sensitized paper rather than Kodak film. An automatic motor-driven timing device replaced the usual mercury contact metronome.

In a review of the literature *Greenwald* (4) has shown that present investigators demand certain electrical refinements for valid and comparable measurements. Our apparatus met these requirements. It was set up in an experimental laboratory consisting of two rooms arranged as a small motion-picture theater. The larger room contained a number of chairs. A projection screen (4½ x 3¼ ft.) coated with aluminum paint was mounted on the wall at one end of the room. At the other end a door led to a smaller projection-booth which was insulated from the larger room by a double celotex wall. *O* was alone during the presentation of the picture and *E* could watch him from the projection room windows while attending to the recording apparatus.

Since we desired to record verbal observations at a time when *E* would not be present in the observation room, a microphone was placed near *O*'s mouth. The input to this microphone led through a vacuum tube amplifier to *E*'s head-phones. The amplification was sufficient to conduct sounds of very weak intensity, as weak as those of breathing changes. Although the presence of the microphone complicated the situation, it did not seem to arouse an undesirable attitude in the adult group. The amplifying apparatus was a modified form of hearing aid recently described (10).

Through a double glass window a Model A Kodascope, using a 200 watt lamp, projected the stimulus pictures upon the screen. Although this machine was not as quiet in operation as some of the newer types, the insulation of the projection room permitted only a faint sound to reach *O*.

In order to permit identification of the parts of the picture at which dermal responses occurred, a method of synchronizing the projector with the recording film was devised. This consisted of a system of speed reducing gears driven by the projector. During each revolution the slowest shaft of this system closed a mercury key which flashed a light at certain scenes in the picture and marked these points on one edge of the photographic record. On the other edge of the film a similar light circuit, closed by a hand key, served to indicate places at which observations were made. The complete photographic record thus included the dermal response-curve, vertical bars to indicate time intervals, points of synchronization with the picture, and similar points denoting *O*'s reports.

IV. Experimental procedure. Since the *O*s gave verbal reports during these experiments, it was necessary that those unskilled in mental inspection be given some degree of training and that those who were already skilled gain some practice in the motion picture situation. Training sessions for each *O* varied indirectly in number with the person's skill in observation.

In these training periods two reels of motion pictures were used, differing in content from those in the recording series. The reels were a comedy entitled 'The Bathing Beach Boob,' which contained the usual series of disconnected misadventures considered humorous in the 'movies' of 1926. Since the *O*s were adults, affective elements connected with humor seldom were present and the picture proved to be a very poor stimulus for any but purely cognitive associations. Each *O* went through one or more training periods until he could report bodily changes as slight as those aroused by this stimulus. It was not assumed that the *O*s were thus equalized as to skill in observation but *E* was fairly well assured that each person possessed a minimum degree of this ability.

As an introduction during the first training period, *E* read to *O* a general explanation of the purpose of the experiment and of the report expected from him. *O* was invited to interrupt with questions during the reading and at these points *E* explained more fully what was desired. Emphasis was placed on the fact that no stimuli other than the motion pictures would be presented.

O then was seated in an ordinary classroom armchair to which the electrodes and microphone were attached. According to the standard technique, his left palm was cleaned with 95% ethyl alcohol and the electrodes adjusted. The microphone was moved into place and the projector started. During the training periods, *E* remained in the room with *O*, giving further instruction as to the type of data desired and asking occasional questions when the observations were obscure.

Previous to the reading period, while he was adjusting the electrodes and the microphone, *E* briefly instructed *O* to report sensations, of the cutaneous, kinesthetic and visceral types with their approximate location and degrees of pleasantness or unpleasantness, imagery of various sorts, apprehensions or anticipations, and degrees of interest. *O* was informed that certain of his observations would be noted by means of the microphone pick-up. Any further questions were answered. *E* then went into the projection-room and started the recording apparatus and the projector. During the experiment, *O*'s movements were noted and his reports written down. After each reel, a period of 15 to 17 min., a brief rest was given and the observations discussed for the purpose of explanation and amplification. Memory images which could not be reported easily at the time of arousal were obtained in detail at this time. The second recording period was from one to three days later, at which time the sequel picture was shown. The instructions and procedure were identical with those for the first recording.

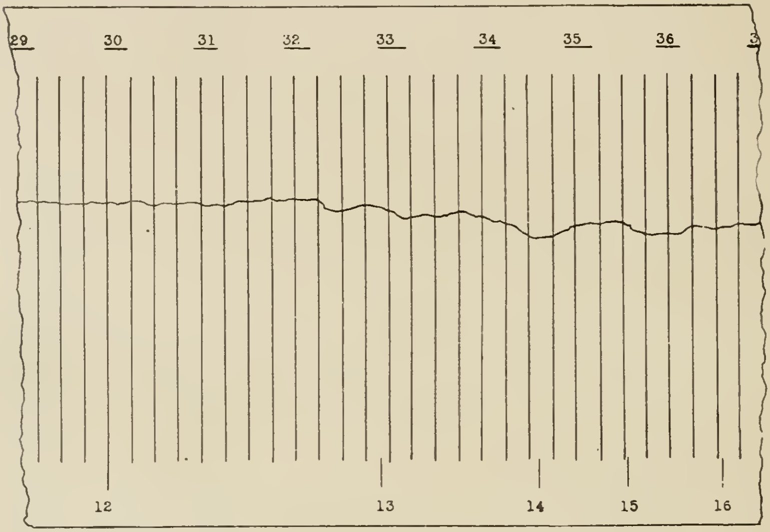


FIG. 1. Record showing effect of chuckling and speech (R 39, RT^2, F)

A great variety of introspective observations was requested for two reasons: (1) since the stimuli were mild, we were doubtful as to just what responses they might arouse; and (2) the material *O* reported was not basic to the main aim of the investigation, but was used chiefly in interpreting results.

V. *Data.* The data collected were thus of two kinds, electrodermal responses and verbal observations. Both of these were synchronized with the stimulus picture and with each other. Thus three analyses were possible. The dermal responses could be studied in relation either to the point in the stimulus picture where they occurred, or to the verbal observations accompanying them. Thirdly, the verbal observations could be correlated with the stimulus picture. In this research, we analyzed only the dermal responses and the verbal observations which accompanied them.

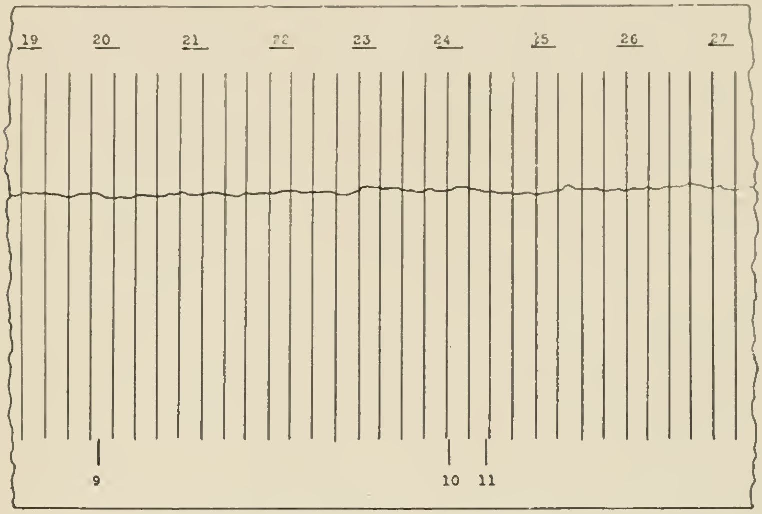


Fig. 2. Record showing no effect of chuckling and speech (R 39, RT^2, F)

All dermal changes due to movement and laughter have been eliminated in the calculations below. Gross bodily movements always caused galvanometric deflections, while minor ones did not always do so. Laughter or chuckling might or might not be accompanied by a deflection. Figs. 1 and 2 were taken from the same record to illustrate this fact. In Fig. 1, at points 13 and 15, *O* was chuckling with a heartiness which sounded to

E about equal in intensity to that in Fig. 2, points 9 and 10. Yet Fig. 2 shows no galvanometric deflection while the first one does. In Fig. 1, at point 14, *O* reported a 'thrill' accompanying the humorous response. We concluded from this and other similar examples that the humorous responses in the two instances differed in physiological organization. This conclusion was somewhat justified when we summated the number of verbal reports of humor, amusement, and laughter and noted how many of these were accompanied by dermal responses. Of the total under these categories, there were 108 reports which were concomitant with dermal responses and only 25 which were entirely unaccompanied by dermal changes. Although these figures showed no exact relationship between the feeling of amusement or humor and the dermal response, they did suggest that the latter is often a part of the physiological pattern in the expression of humor, but not always a member of such patterns. There is some evidence for a hypothesis that laughter, humor, or amusement have a different physiological organization, rather than being different in degree only.

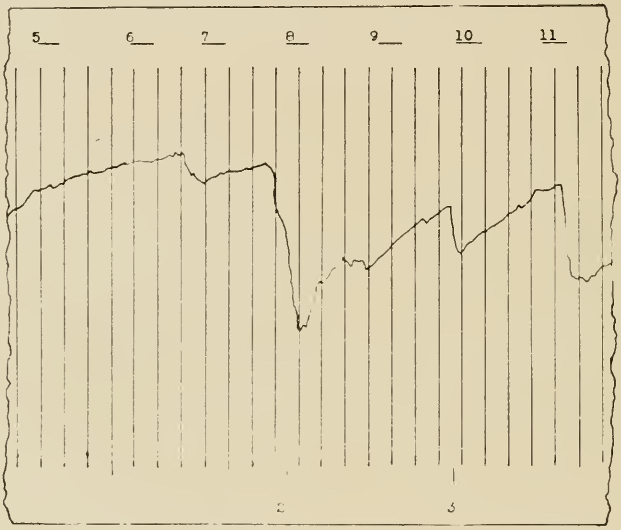


Fig. 3. Record accompanied by definite affective tone (R 60, RT[1], F)

Some investigators who have used the EDR[1] technique believe that the movements of unaffective speaking result in a galvanometric deflection which may be interpreted as a dermal response. Our evidence is against this possibility. In the majority of dermal responses accompanied by verbal reports, speech occurred from 5 to 10 sec. after the initiation of the dermal drop in resistance. This fact alone is evidence against the hypothesis that EDRs are due to simple speech movements.

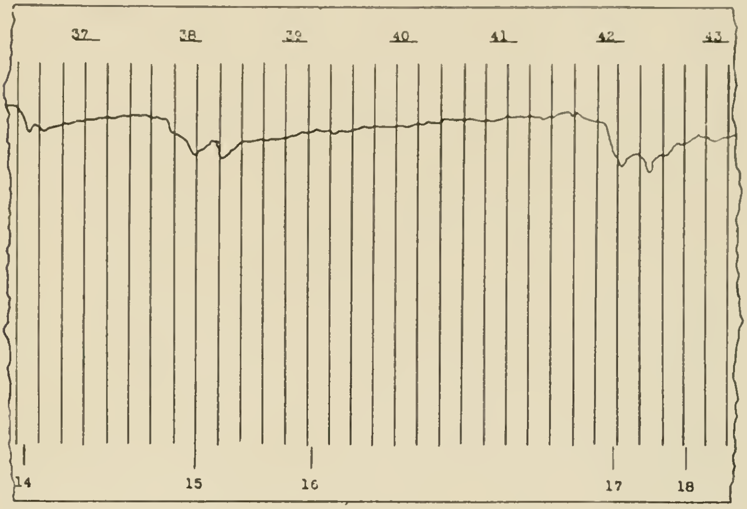


Fig. 4. Record accompanying affective mental images (R 37, BT^2, M)

Fig. 2 shows several instances of speech unaccompanied by a dermal change and in Fig. 1 are two similar examples (points 12 and 16). From the data here presented the EDR evidently does not occur with unaffective speaking, although further research would be necessary to establish the point conclusively.

Figs. 3 and 4 show some EDRs of definite affective tone, so described in the accompanying verbal reports. In Fig. 3 the report at point 2 was a 'feeling of tension in the muscles of the jaw' and at point 3, a 'suspense.' These affective changes were quite intense, as indicated by both the record and the verbal reports. Fig. 4 illustrates verbal reports of two mental images which were toned affectively. At point 15, *O* reported visualizing a girl who somewhat resembled the heroine in the picture and whom he remembered unpleasantly. At point 17, a checkered shirt worn by a character in the picture had caused *O* to image a valuable blanket that had been stolen from him. The EDR was a part of the total affective feeling relived whenever these images were aroused. Fig. 5, at point 21, was another example of a visual image correlating with an EDR. Here *O* visualized a definite cot upon which he had lain while acting as *O* in other experiments. The response was called up by two separate views of a cot in the stimulus picture and *O* reported at the time of the second arousal. Two response dips are seen in the curve, the second at the time of the report. Instances such as these indicate that, in spite of instructions, many feeling changes occurred which remained unreported.

---

[1] In the following discussion EDR has been substituted for the term 'electrodermal response.'

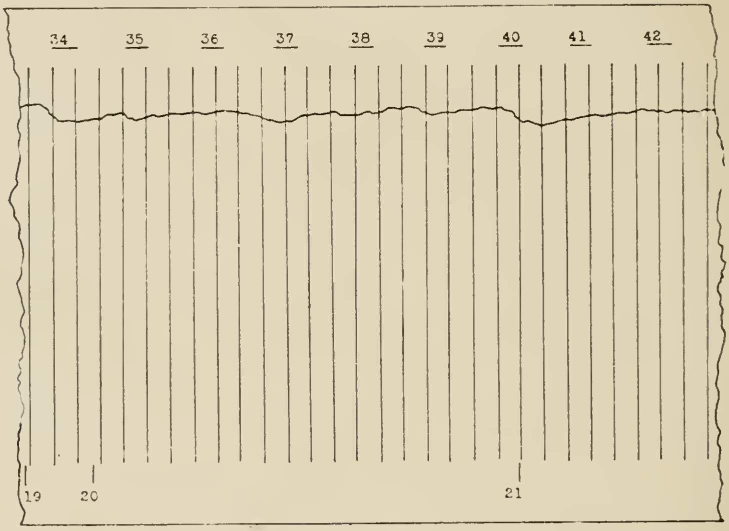


Fig. 5. An EDR correlating with a visual image (R 36, BT[1], M)

VI. Analysis of EDR data. The dermal response records were read in ohmage units and reported in percentage of change from the basic resistance, as is customary in the treatment of these data. All analyses were made in terms of these percentage units.

With our apparatus it was possible to read a minimum variation of 50 ohms. Although each record contained a number of these small variations, they were difficult to read accurately and were sometimes due to voltage changes in the power supply. For these reasons an arbitrary lower limit of 300 ohms was fixed as the minimum change which would be considered a dermal response.

Though each EDR record was unique in form, certain similarities were at once apparent. In determining the best method of treating these records statistically so as to preserve their differences and similarities, several methods previously used were tried and discarded. Three measures, the total number of responses, their mean value, and the standard deviations from this mean proved the most descriptive.

Table I shows the number of responses and their mean values for 20 *Os*. The mean is considered the most stable measure of central tendency and also the best to describe any aggregate of discrete measures. Thus it should be the best measure for our study of individual differences. However, the number of responses also varied greatly, as Table I shows, the range being from 2 to 83 for one reel of stimulus picture. This fact suggested that N also could be used as a measure of individual differences, unless it correlated well with the mean, in which case they might be almost equivalent measures. Such was not the case. The correlation between the mean response and the number of responses was $r = .28 \pm .13$. This was a low correlation and hardly to be expected in view of the fact that N was a factor in computing the mean and therefore might increase the relationship. Although there was a relationship between the two measures, we concluded that we were justified in using both in describing the data.

In this connection it was interesting to note that the correlation between the sum of the responses and the number of responses was $r = .70 \pm .05$. It was at once apparent from this closer relationship that the mean response would be more valu-

TABLE I. *Number and mean values of responses of 20 Os*

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
RT1																				
N	20	37	15	67	31	20	76	49	9	46	14	2	28	44	52	38	36	83	13	82
M	5.2	3.5	4.9	7.6	11.4	12.9	4.8	13.4	2.7	7.1	8.0	10.5	16.2	14.5	9.1	7.7	8.5	11.4	3.5	9.8
RT2																				
N	59	66	22	49	27	8	60	47	16	39	19	8	23	67	64	29	38	67	13	80
M	5.4	4.6	6.8	6.7	6.8	5.4	5.4	12.2	2.8	8.1	5.1	7.0	11.1	15.4	7.8	7.1	5.5	14.4	2.9	10.8
N	79	103	37	116	57	28	136	96	25	85	33	10	51	111	116	67	74	150	26	162
M	5.3	4.2	6.0	7.2	9.7	10.8	5.1	12.8	2.8	7.5	6.0	7.7	13.9	15.0	8.4	7.5	6.9	12.7	3.2	10.3
SD	3.8	2.2	4.5	4.0	7.4	4.8	1.0	8.1	1.8	3.3	4.8	3.7	5.9	7.8	6.3	6.9	2.8	7.2	2.0	7.3
RT1–2																				
BT1																				
N	50	73	32	75	42	7	68	5	14	40	29	32	14	51	77	27	11	61	15	67
M	6.8	5.3	5.7	10.7	13.9	9.7	4.6	6.8	1.8	8.9	9.4	7.4	10.0	12.1	8.8	6.0	2.4	8.1	3.4	12.3
BT2																				
N	76	67	42	62	25	34	62	22	13	53	26	17	10	78	82	21	32	59	10	83
M	7.2	3.7	8.5	13.7	10.5	13.0	5.3	8.5	3.2	9.7	7.0	13.0	7.2	10.2	8.9	5.4	4.8	11.0	2.8	13.2
N	125	138	74	137	67	41	130	27	27	93	55	49	24	129	159	48	43	120	25	150
M	7.0	4.5	7.3	12.1	12.6	12.4	4.9	8.2	2.5	9.4	8.1	9.4	8.8	10.9	8.9	5.7	4.2	9.6	3.1	12.8
SD	4.8	2.4	4.8	7.6	7.4	7.6	3.3	4.0	1.8	3.5	6.2	4.0	7.1	7.9	5.6	3.9	2.7	3.9	2.1	10.8
BT1–2																				
RT1–2, N/M	15.0	24.5	6.5	16.1	5.8	2.6	26.6	7.5	9.0	10.1	5.5	1.3	3.6	7.4	13.8	8.9	10.7	11.8	8.1	15.7
BT1–2, N/M	17.9	29.6	10.1	11.3	5.3	3.3	26.5	3.3	10.8	9.9	6.8	5.2	3.7	11.8	17.8	8.4	10.2	12.5	8.0	11.7
Assigned Quotient	16	27	8	14	5	3	26	5	10	10	6	3	4	10	16	9	10	12	8	13

In the vertical column at the left, RT1 refers to the picture 'Riding Thru,' Reel 1; RT2 to 'Riding Thru,' reel 2; RT1–2 to 'Riding Thru,' reels 1 and 2. Similarly, BT refers to the picture 'Battling Travers,' the same reel designation being used. N is the number of responses; M and SD are the mean response and and the standard deviation respectively. Roman numeral at head of vertical column designates *O*.

able in describing the data than the sum of responses, when either was used in connection with N. The SDs of the means also were calculated. These were found to be large in comparison with the mean value from which they were taken, thus demonstrating the great variability of the responses.

As an indication of the relative reliability of the three measures, postulating that our two experimental situations were equivalent, coefficients of reliability were obtained between values in the two parts of the experiment. The correlation between the means from RT1–2 and those of BT1–2 was $r = .68 \pm .08$. A similar correlation between the numbers of responses to the two pictures gave $r = .79 \pm .06$, while for the SDs the coefficient was only $.61 \pm .10$. Thus we saw that of the three measures, the mean response and number of responses had the highest reliability, although neither was extremely reliable.

The standard error of estimate for the mean response to each reel was 1.9. Thus the chances are 68 in 100 that the mean obtained on such an experiment was within 1.9 points of the 'true' mean and it was almost perfectly certain that the obtained mean lay within 5.7 points of the 'true' mean. The standard error of estimate for N was 19. With this measure the chances are 68 in 100 that the obtained N was within 19 points of the 'true' N and it is nearly certain that the obtained N was within 57 points of the 'true' N. Similarly, the measure of variation, SD, had a standard error of estimate of 2.8. Here the chances were 68 in 100 that the obtained variation was within 2.8 points of the 'true' SD and it is almost certain that it lay within 8.4 points of the 'true' SD.

Because each standard error of estimate is so large, in comparison with the mean from which it is derived, the above analysis showed very clearly the futility of using one of these three measures as an index of *O*'s EDR activity in a mild stimulus situation. Since N and the mean were most reliable and easiest to obtain, several different combinations of them were tried in an effort to obtain a single measure which would be an adequate index of the dermal response activity of any individual. The best measurement discovered was a simple division of N by the mean, which we called the 'dermal response quotient.' These quotients[2] for each stimulus picture are given in the second and third rows from the bottom of Table I.

The correlation between these quotients for the two stimulus pictures was $r = .92 \pm .02$. This was fairly high when one considered the many possible differences between the two experiments, *i.e.*, inequality of stimuli, change in attitude, different times of day, chance individual variations, *etc.* It was clear that this measure gave a more reliable index of EDR activity than any of the other separate measures.

We tried to discover some statistical justification or condemnation for this quotient to make certain that its higher predictive value was not merely a statistical artifact. The literature in mathematical statistics was found to contain little information which would be applicable and it appears that the solution of the equations necessary to answer our question would be the equivalent of a doctorate thesis in that field. However, the evidence at hand argues against the belief that the gain in reliability was due only to mathematical juggling and not to a more valid way of expressing the data.

A simple calculation will show that the dermal response quotient obtained by dividing the number of the responses by their mean is equivalent to squaring N and dividing this square by the sum of all of the responses. Thus a higher reliability resulted when N was given its squared weight with respect to the total amount of deflection. One statistical explanation of this fact was that the original data for either N or M gave a curvilinear regression and when these data were used in a product-moment formula the result was a spuriously low correlation. If this were true, then possibly the regression was made more rectilinear when the quotient data were used. Inspection of the scatter-diagrams in the case of N, M, and the quotient values shows that this explanation is possible, but the number of *O*s was too small to permit a more definite statement. However, the scatter-diagram of the quotient values shows the regression to be quite rectilinear and that values to cluster more closely about the line of regression than in the case of the other measures.

---

[2] *Darrow* and *Heath* (1) have used a 'recovery-reaction quotient' which they obtained by dividing the increase in ohmage resistance during the three seconds following the peak of the reaction by the decrease in ohmage resistance from the stimulus to the peak. This quotient was used in an effort to cancel the effects of the physiological factor in the electrodermal response. However, it did not correlate well enough with other measures to be valuable in predictions.

A possibility still remained that the square of N was not the optimal weight and that a still greater increase of N's relative value would result in a higher reliability. Therefore N was cubed and divided by the sum of the responses for each individual, *i.e.*, N was squared before being divided by the mean. The reliability of the data treated thus was reduced to $r = .71 \pm .07$. In this case the scatter-diagram showed a skewed distribution. This skewing when N is cubed also argues that the quotient distribution approximates normalcy.

It appeared from this reasoning that for optimal reliability N must be weighted in relation to the sum of the responses by an amount somewhere between its raw value and its cube, with its square having the advantage of giving a high reliability and being easy to obtain. The reliability of the raw N divided by the sum of the responses was close to that of the reliability of the mean (Σ / N) which consistently has an inverse ratio. This reliability was shown above to be $r = .68 \pm .08$. Reasoning from these three correlation coefficients and from the scatter-diagrams we may suspect that the optimal weight of N approximates its square. However, a more exact weighting must await much further calculation upon more extensive data.

The above dermal response quotient correlation indicated that each *O* tended to rank at the same place in the group in the two experiments. This is confirmed by Table I. Eleven persons showed a quotient gain while nine showed a loss in the second experiment. The greatest gain was 5.1 points and the greatest loss, 4.8 points. Both of these values were within the range prescribed above by the standard error of estimate. These quotients were based, with one exception, on a number of EDRs greater than 24. The exception was in the case of *O* XII who gave only 10 EDRs during the first experiment. Since she showed a quotient gain of 3.9 in the second experiment, it may be suspected that the first value was not valid. It is probable that approximately 25 EDRs are necessary to establish a valid quotient.

It should be noted in passing that there is no obvious reason why the quotients should be as nearly constant as they are in Table I. The majority of *O*s had a greater number of responses during the second experiment. Also, these *O*s had corresponding increases in average amount of response so that the dermal response quotient approximated the same value as the first. We conclude that the number of responses and their increase in amount tended to vary concomitantly, resulting in the high correlations between the quotients. Because of this variation and because of the degree of constancy exhibited in the quotients we felt that the latter, when based upon an adequate number of dermal responses, might be used for investigating individual differences.

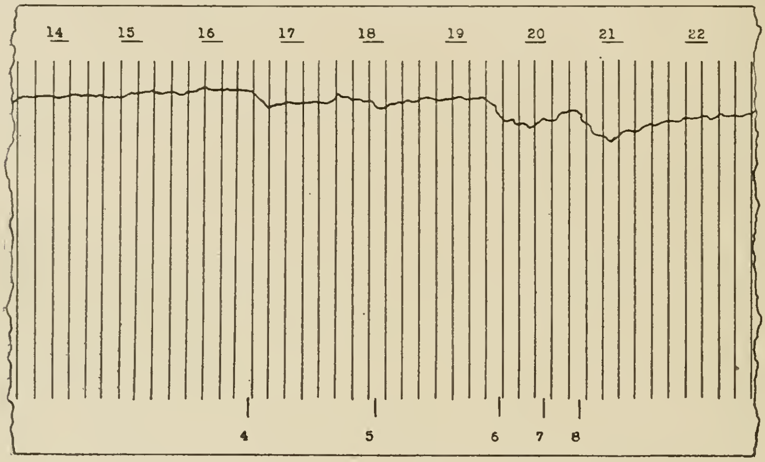


Fig. 6. A dermal response quotient value of 3 (R 37, BT^2, M)

Each *O* was assigned a rounded midpoint number between the two quotients obtained in the two experiments. These are shown in the last line of Table I. In terms of these units our *O*s varied from three to 27 points and were uniformly distributed. Although these differences may seem to be a matter

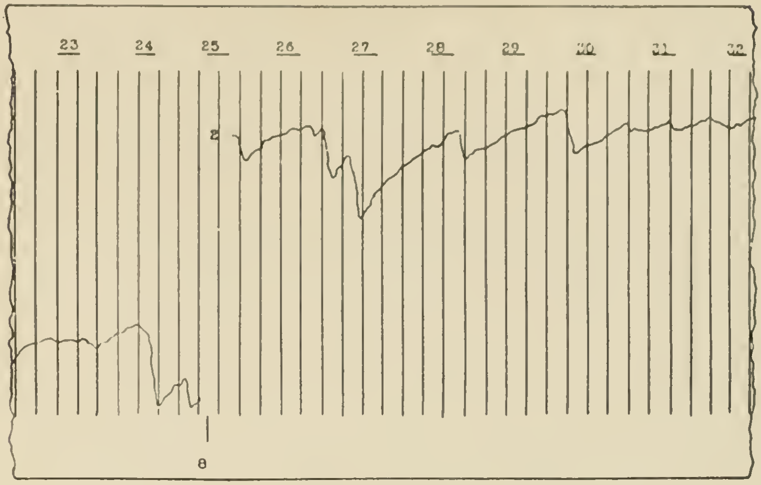


FIG. 7. A dermal response quotient value of 9 (R 62, BT¹, F)

of only a few points, it must be remembered that they were based upon stimuli of every slight intensity, presented to a highly select group, and the fact that they showed a range as great as 24 points was therefore the more remarkable. Had stronger stimuli been used or had the *O*s been a group more representa-

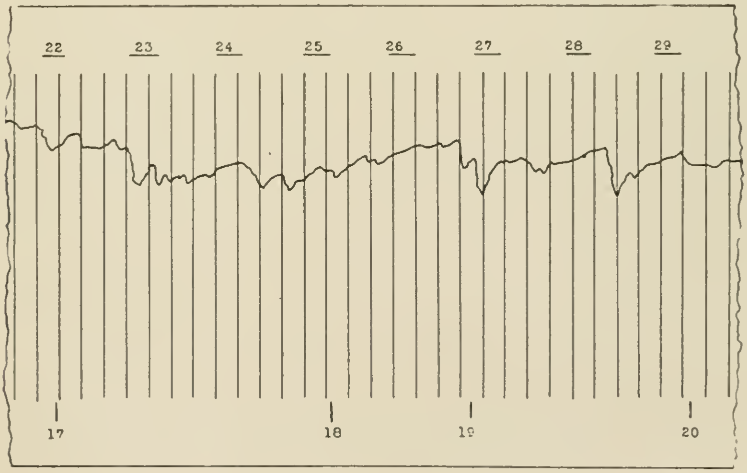


FIG. 8. A dermal response quotient value of 26 (R 21, BT², M)

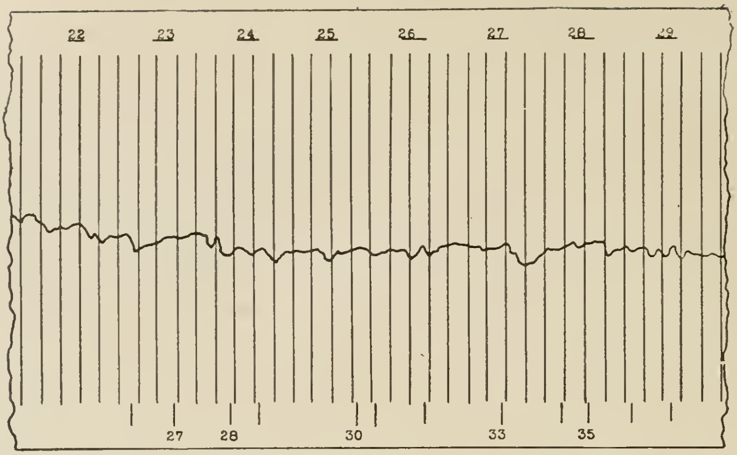


FIG. 9a. A dermal response quotient value of *27* (R 7, BT^2, M).
To be compared with Fig. 9b.

tive of the general population, the range of differences quite possibly would have been greater. There appeared to be little evidence suggesting any distinct groups, although for conven-

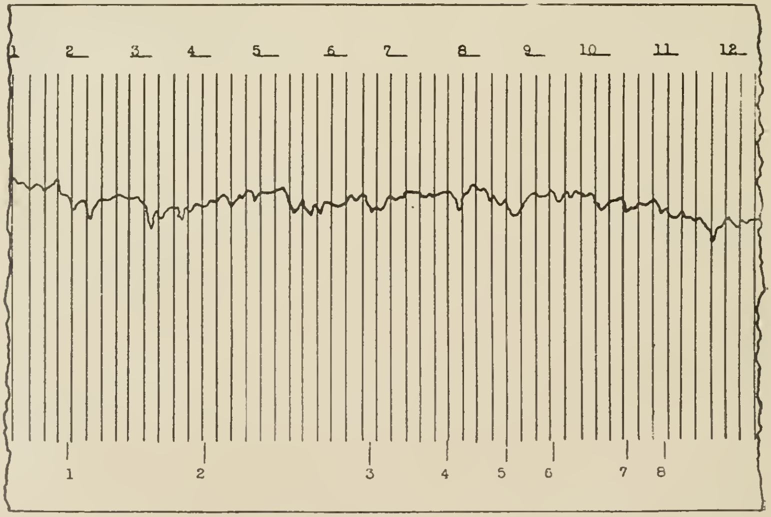


FIG. 9b. A dermal response quotient value of 26 (R 19, RT^2, M).
To be compared with Fig. 9a.

ience we might put arbitrary division lines at points 10 and 20, thus distinguishing a low, a medium, and a high group. How well these values describe the actual record made by the individuals may be judged from Figs. 6, 7, and 8. Fig. 6 is a record of an *O* with a dermal response quotient of three, Fig. 7, of nine, and Fig. 8, of 26, respectively. A low quotient, as in Fig. 6, indicated a record that was flat, showing only a few small EDRs. A quotient of moderate value, as in Fig. 7, indicated an increase both in the number of responses and in their size.[3] A high quotient as in Fig. 8, indicated not so much an increase in the size of the EDRs as an increase in the number of small responses accompanying many responses of moderate size.

Figs. 9a and 9b are included to show further the descriptive value of the quotients. They illustrate the likeness between the records of *O*s having a similar dermal response quotient. The figures were portions of records taken from two male *O*s during two separate experiments. The quotient value of Fig. 9a was 27 while that of Fig. 9b was 26. The similarity of these records is obvious. They are typical of the data in general and illustrate the factors of number and size of response which obtain in records having a similar dermal response quotient.

VII. Sex differences. The data were analyzed carefully in order to discover any consistent difference between the sex groups. The average numbers of responses were as follows: RT1–2, female, 80, male, 76; BT1–2, female, 80, male, 86. The male group was slightly more variable in the number of EDRs to the two experiments but the values were more remarkable for their similarity than for the small difference between them. The means were likewise very consistent in the groups. They were: RT1–2, female, 9.2, male, 7.1; BT1–2, female, 8.1, male, 8.1. Here the differences between the groups were small enough to suggest equality.

In the measure of variability, differences between the groups were slight but nevertheless present. The female group showed an average SD of 5.47 to RT1–2, and 5.42 to BT1–2, while the male group had averages of 4.09 and 4.72 respectively. In view of the fact that other experiments have shown the female group to be more variable in EDR it was believed that this consistent difference was real and that its smallness was due to the close matching of the sex groups.

---

[3] Fig. 7 also illustrates the break which occurs in the record line when the dermohmograph was shifted from one reading range to another.

A similar analysis of the dermal response quotients also yielded a uniform difference. The average quotients were: RT1–2, female, 8.7, male, 12.4; BT1–2, female, 9.6, male, 12.9. Here the female group averaged three to four points, or about 25% less than the male group on the two experiments. This fact was the more remarkable when it is remembered that the dermal response quotient was based upon measures which, taken separately, showed no large group differences. We therefore conclude that there are sex differences present in the general population which are probably larger than those obtained in this study, that the female group in such a population probably would show a greater variability than the male, and that the male sex as a group has a greater dermal response quotient.

VIII. Conclusions from the EDR data. We conclude from these data that:

(1) Neither the number of responses, nor the mean response, nor yet the standard deviations, proved adequate to describe an individual record.

(2) A single measure called the 'dermal response quotient,' derived from the division of the number of responses by the mean value was *(1)* as descriptive a measure as could be found for individual differences, and *(2)* quite stable in value from the first experiment to the second, *i.e.*, it had a higher reliability than any other single measure when established on 25 or more EDRs.

(3) Individuals tend to vary in terms of their dermal response quotient over a range of 27 units, for an adult group exposed to mild stimuli. The range doubtless is greater for the general population.

A low quotient indicated a 'flat,' small type of variation record, and a large one a record with many small EDRs superimposed upon some large variations.

(4) The female group showed a slightly larger standard deviation consistently, suggesting greater variability, while the male group was about 25% greater on both experiments in terms of the dermal response quotient.

IX. Verbal report data. In may be argued that these individual differences in EDR are purely physiological phenomena, totally unrelated to any mental component. Were this true, the fact of their existence would still be of value to physiological psychology. The reason for requesting verbal reports from the *O*s was partially to discover the truth of this argument and partially to discover whether adult *O*s were aware of any affective changes to stimuli of such a mild nature.

In an examination of all verbal report data we found that none of the *O*s noted a feeling strong enough to be classed as an emotion. The strongest experiences felt were probably those reported as 'thrills.' However, the majority of observations were of the type that anyone who is conversant with the field of emotion, in inspective terminology, recognizes as denoting affective qualities or concomitants of these qualities. The instructions were, of course, worded to bring out these feeling changes, but the range allowed was very wide and other data were reported, *i.e.*, the purely cognitive associations.

Some unreported preliminary analyses as to groups or types of these reports were tried, but it quickly became evident that the experimental conditions of necessity had been too crude to produce mental inspections exact enough for such analysis. Further experimentation with stimuli of a similar mild character but of shorter duration doubtless would yield more precise verbal report data. Also, reports were given at almost every point in the pictures, however indifferent these spots might seem to *E*. Therefore, in this study a simple threefold classification of verbal responses was used to illustrate the relation between affective and non-affective changes and the dermal response. An observation which was the result of, contained, or was concomitant with, some affective quality or change, was denoted by the letter A. Those in which this element was absent or very slight were marked with the letter I.[4] The group to which the observation belonged was indicated by *O* either in the report proper or in the discussion period following each reel of motion pictures so that the classification was not merely *E*'s opinion. Those reports about which *O* was doubtful, in regard to the presence or absence of affective quality or change, form a third group, which was not marked with either letter. Certain of these observations were accompanied by EDRs, others were not. The former were marked with a star, in the examples given below.

The 20 *O*s gave a total of 1,375 verbal reports during the two experiments, or an average of 69 apiece. Of these, 1,005 were of the A classification, 307 classed as I and the remainder, doubtful. Thus the average number of A reports was 50; the I reports averaged seven. The instructions therefore were effective in producing reports of feeling components in the great majority of cases. Samples of these three types of observations chosen at random are listed below. The symbols are interpreted as follows: the Roman numeral designates the *O*; BT1, *etc.*, indicate the stimulus pictures as noted previously; M refers to a male *O* and F to a female *O*, respectively; the number preceding the observation served merely for identification and synchronization with the dermal response record. Those parts of the observations which are in parentheses were obtained during the rest period between experiments.

VI. BT1, M.

*A 8 Olfactory imagery as Archie smelled the flower. (Very pleasant. Was quite distinctly the odor of a rose.)
I 11 Cleared my throat.
*A 18 Felt a 'hell of a jolt' just below the diaphragm when he jumped on the horse.
21 Moistened my dry lips again.
27 Considerable anticipation. Find my fist is closed. Don't know why.

---

[4] Whether or not the affective element is ever entirely absent in any experience is an unsolved psychological question. We recognized this fact and would justify our classification only upon practical grounds.

IX. RT1, M.

*A	4	Slight tension in the upper chest
*A	5	Pleasant feeling while looking at the trees.
I	8	Took a long breath.
*A	9	Slight tension all over.
I	10	Short breathing.

XIV. RT2, F.

*A	2	Slowing of heart. Muscles around it tightening. Then a sort of sharp quickening.
*A	3	Prickling of the skin along the veins of the neck.
*A	4	Anticipation. Will he dare go in?
*A	5	Creeping sensation across the shoulder.
*A	9	Pulsing up and down the back of the neck.
*A	18	Tightening of abdominal muscles.

XX. BT1, F.

*A	2	Suspense. Breathing somewhat faster and heart beating faster.
*A	3	Quickened breathing.
*A	4	Increasing interest in the plot.
*A	5	Sensation in the stomach. It feels as if my heart is beating down there.

These sample observations illustrate the wide range of material presented and the way in which it was handled. For example, *O* IX, in observation 19, considered the report to be of the I type while *O* XX, in observation 3, in reporting much the same material, felt that it was concomitant with affective change. In such cases we could only assume that the *O*s were reporting faithfully and trust that any inherent errors would be cancelled in the larger mass of data. Again, *O* VI, in observation 21, was unable to determine in which category the report belonged, since the atmosphere in the laboratory might have been responsible for the dry lips observed. He was also uncertain in report 27, which appeared to *E* to belong in the A group. Such undesignated observations were omitted in the following calculations.

An analysis of reports was made for each experiment. Because the two were nearly identical in form and values, they were combined in Table II. V refers to the number of verbal reports given. The other rows are percentages as indicated. It was noted first that for all *O*s there were a great many more reports classified as A than as I. In only one *O*, VIII, were the two

TABLE II. *Number of verbal reports given, classified as to type and relation to* EDR

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
V	71	155	43	99	69	115	132	81	59	51	36	43	49	59	80	52	34	59	48	40
A	44	94	28	76	47	81	100	31	38	34	32	36	39	57	70	45	27	49	40	37
I	27	55	16	23	20	18	23	30	18	12	4	6	9	2	10	7	7	10	8	2
A/V x 100	62	60	65	76	68	70	75	38	64	66	90	83	79	97	87	86	80	83	73	92
I/V x 100	37	35	37	23	28	15	17	37	30	23	11	13	18	3	13	14	20	17	27	5
EDR	204	241	111	253	124	69	266	123	52	178	88	59	75	240	275	115	117	270	51	312
A & EDR	36	67	9	48	38	35	87	25	34	34	24	19	35	55	65	37	17	45	35	37
I & EDR	11	18	4	14	9	4	13	20	2	9	1	3	3	1	1	2	5	1	2	2
A & EDR/EDR x 100	17	27	8	18	30	50	32	20	65	19	27	32	46	23	23	32	14	17	68	11
I & EDR/EDR x 100	5	7	3	5	7	5	4	16	3	5	1	5	4	0	0	1	4	0	4	1

Roman numeral at head of column denotes *O*. V, number of reports given verbally. A, I, have meanings given previously.

anywhere near equal in number. It also may be noted that many reports were undesignated or doubtful for this *O*. Although the instructions were worded to bring about reports of affective qualities and changes, the percentage of indifferent reports was large enough to show that these instructions were not entirely heeded. From the calculations we conclude that during these experiments all *O*s certainly were aware of feelings and affective changes which were intense enough to be reported.

More interesting, perhaps, is the relationship between the dermal responses and the verbal reports. It was seen immediately that the majority of the EDRs were not accompanied by verbal reports. Inspection of rows 6, 7, and 8 in Table II showed this clearly. The number of EDRs is spuriously high because many of them were of the *Doppleschwankungen* sort and consequently were read as two where only one truly existed. Still, the conclusion holds that there were many electrical changes without verbal reports of any sort attending. Whether or not these were related to the affective life of *O* or were unconscious physiological changes must remain a conjecture. It was the opinion of *E* that many of them were related to affective changes which *O* failed to report or which he was unable to report due to the rapid forward movement of the stimulus. Further experimentation which exposed trained *O*s to mild stimuli of shorter duration would aid in showing just how close the relationship is between the electrodermal response and the affective life. There were also reports made with no accompanying EDR, as illustrated above (Fig. 2). In these cases, which were comparatively few, the majority of the reports were classed as I, although some were held by *O* to be affectively colored.

In rows 7 and 8 the numbers of each type of response are given, while in the last two rows these numbers are turned into percentage values for the purpose of direct comparison. It was seen here that without exception the reports which were affectively toned were those most often accompanied by dermal responses. These percentages favored the A grouping because this group also excelled in sheer number of reports, but the difference was great enough to show the predominant relation between the A class of report and the EDR.

X. Conclusions from the verbal report data. It was evident that the *Os* actually were cognizant of affective changes or qualities in the majority of their observations. The close relation between the EDR and the conscious affective life thus was once more sustained. There was evidence, however, to show that the relationship between the EDR and the felt affective quality or change was not perfect. In a small minority of cases, verbal reports were given of feeling changes unaccompanied by any dermal response. Again, there were many EDRs without any inspective report accompanying them. The possibility existed that this relationship might have been more evident with more highly trained *Os* and a stimulus which moved forward in time more slowly.

It was our opinion that these results could be best interpreted by viewing the EDR as a physiological part of many and varied affective processes but not as a member of every pattern in the affective life. This view was suggested by the neuro-anatomy and the general unitary functioning of the autonomic system. The number and variety of feeling changes of which the EDR was a part can be inferred from Table II and the sample verbal observations. Furthermore, reported feeling changes were of slight intensity where the EDR was quite obvious. Thus it served as an indicator of many subtle affective changes. Fig. 4 shows the response to a memory image reported as only slightly unpleasant.

Whether or not the EDR is a part of the more highly developed or persevering phases of the affective life as the sentiments, moods, dispositions, *etc.*, might be discovered by further analysis of those persons having dermal response quotients of definite values. However, our data justify the use of the EDR as a physiological indicator of the majority of affective changes, including many which are less intense than the emotions. It is indeed a very good example of the nice relationship obtaining between somatic behavior and psychical processes.

Bibliography

1. Darrow, C. W., and Heath, L. L. Reaction tendencies relating to personality, (in) Studies in the dynamics of behavior. University of Chicago Press, 1932.
2. Dysinger, W., and Ruckmick, C. A. The emotional responses of children to the motion pictures. N. Y., Macmillan, 1933.
3. Greenwald, D. U. Electrodermal responses of abnormal individuals (this volume, pp. 28–39).
4. Greenwald, D. U. Review of apparatus for the measurement of electrodermal response, *Psychol. Bull.*, 32, 1935, 779–792.
5. Greenwald, D. U. A dermohmograph for the measurement of electrodermal response, *Amer. J. Psychol.*, 47, 1935, 682–685.
6. Landis, C., and DeWick, H. N. The electrical phenomena of the skin, *Psychol. Bull.*, 26, 1929, 64–119.
7. Landis, C. Electrical phenomena of the skin, *Psychol. Bull.*, 29, 1932, 693–738.
8. Porter, J. P., and Copeland, H. A. Association and psychogalvanic responses during early adolescence, *Proc. Ninth Int. Cong. Psychol.*, 9, 1929, 349–350.
9. Ruckmick, C. A. Terminology *in re* psychogalvanic reflex, *Psychol. Rev.*, 40, 1933, 97–98.
10. Taylor, S. O. The Radio News ear aid, *Radio News*, 13, 1932, 576–577, 628–631.
11. Wechsler, D., Crabbs, L. M., and Freeman, R. S. Galvanic responses of preschool children, *J. Genet. Psychol.*, 38, 1930, 203–222.

ELECTRODERMAL RESPONSES OF ABNORMAL INDIVIDUALS

by

D. Ulrich Greenwald

I. Introduction. Variations in dermal resistance to the passage of an electric current during emotion have been studied for several decades. *Landis* and *DeWick* (4) and *Landis* (5) have summarized the literature in this field. They point out that while the electrodermal response is not a specific correlate of emotion, it may be interpreted in relation to the functioning of the autonomic nervous system, particularly of the sympathetic division.

Previous researches in the University of Iowa psychological laboratories have dealt with the effects of motion pictures upon the emotional life of children. The electrodermal response technique and other expressive procedures (1) have been utilized. One of the unsolved problems is: how do the responses made by children and adults compare with those made by persons with known mental and emotional maladjustments? It is important, furthermore, to determine how well the electrodermal response technique, as used in research work on the emotions, is adapted to the study of psychotic and neurotic individuals.

II. Apparatus and technique. In combining the dermal response technique with the motion picture as a stimulus situation, *Dysinger* and *Ruckmick* (1) initiated a new procedure which held several possibilities for our purposes. The present study took over their technique and with certain minor changes applied it to cases of abnormality which were difficult to analyze from the affective aspect. Since the technique already has been reported, only modifications of it will be recorded here.

The experiments were carried on in a laboratory in the Psychopathic Hospital at Iowa City. The stimulus was a two-reel motion picture. By means of a portable DeVry projector a motion picture ($3\frac{1}{2} \times 4$ ft.) was thrown against an aluminum screen painted on one wall of the room. This picture was of the old-fashioned silent type. It has been described in an earlier study as a half-hour presentation obtained from the libraries of the Eastman Kodak Company. The plot was laid in a wicked pagan city of early times; it involved several love-scenes, some of danger and conflict, one scene of riotous pagan feasting and worship, and finally the divine destruction of the city by fire and brimstone. The last part was shown on a red film and formed a very dramatic climax. It was chosen because of all pictures available it contained the greatest number of scenes of types related to strong affective responses.

The *O* sat facing the screen at a distance of about 12 feet, in a comfortable chair, his left arm resting on the arm of a laboratory chair beside him. To the arm of this chair the electrodes were fastened. These were of the calomel (liquid) type previously described by *Ruckmick* and *Patterson* (7), and were chosen because they are relatively non-polarizing and because they are adaptable to the *O*s and the technique. As a further improvement, the openings were placed below the level of the chair arm and over them was placed a thin bakelite sheet having holes in it concentric with the openings. The holes were adjustable to the size of *O*'s finger. *O* sat with his fingers bent, the tips protruding into the solution beneath. At first a strap was placed over the back of the hand to hold it in place but this was found to be unnecessary after *O* had been instructed not to lift his fingers from the electrodes. The hand thus was comfortable and usually escaped *O*'s direct attention.

After contact was made thus, a *Wechsler* (9) psychogalvanograph[1] was used to record the changes in dermal resistance. The instrument was modified to produce a continuous record on sensitized paper during the presentation of an entire reel of the picture. A method was devised for synchronizing this record with the scenes presented on the screen, and provision was made for noting other data on the record, such as movement by *O*, *etc.* This apparatus was placed in the rear of the laboratory near the projector where it could be handled by *E*. Because of the distance to the recording apparatus and the unobtrusiveness of the connecting wire, *O* often was unaware of his relation to the set-up.

---

[1] C. H. Stoelting Co., Chicago, Ill., listed in their general catalogue under No. 24201.

When a female *O* was used, a nurse remained in the room, watching the picture from a seat at *O*'s side. When male *O*s were used, there was no one but *E* in the room. Thus conditions were similar in that two members of the same sex were always present during an experiment.

O seated himself in the designated chair and was told just what he was to do. An effort was made to arouse interest in the picture and to secure co-operation. This was possible in all except one or two cases. Any doubt as to what was going to happen was quieted through suitable explanations and the answering of questions before the experiment started. At the end of an experiment a uniform question was asked of all *O*s, "How did you like the picture?" Responses were noted immediately after *O* had left the room.

Fifty *O*s were chosen from the wards.[2] They included cases listed in the following diagnostic groups: schizophrenia, manic-depressive psychosis, paranoia, organic disorder, and psychoneurosis. All these cases were at one time 'normal' in personality, so we may credit them with 'normal' emotional development up to the point of their pathological deviation.

III. Comparative analysis of the data. *E* was kept in ignorance of the disorders or case histories of the *O*s until he had made all possible analyses of his objective records. This is a point to be kept in mind since only composite data are presented here. Without this precaution there doubtless would have been suggestive influences operating in the interpretation of results.

The photographic records were taken and read in a manner similar to that of the previous study. The galvanograph had been calibrated so that a one mm. deflection of the record-line could be read as a definite percentage of the original dermal resistance.[3] Since *Dysinger* and *Ruckmick* used merely 'reading points,' specific small sections of the picture, only these 'points' were used in the comparative data reported below. Our records, being longer, gave much more material and this has been presented somewhat differently.

---

[2] The writer is indebted to Dr. William Malamud, Assistant Director of the Psychopathic Hospital, Iowa City, for his co-operation in this research.

Dysinger and *Ruckmick* reported average responses of all *O*s to each 'point,' as well as the range of response to this 'point.' Since all of our *O*s were adults we may use the data they report in their Tables III and IV for comparison. After some comparison of individual responses made by the psychopathic *O*s to 'points' with those made by normal *O*s to the same 'points,' it was found that the results could be as well presented—and indeed more compactly—by considering average responses to various kinds of situations. The previous study considered two kinds of 'points,' in the first reel largely suggestive of erotic situations, in the second reel, of danger or conflict. The suggestive 'points' in the first reel for all *O*s, and the danger 'points' in the second were averaged, and the range determined. This material is summarized in Figs. 1 and 2.

The ordinates of the tables represent the range of the individual's response curve, measured in percentage of original dermal resistance. Along the abscissa the cases are arranged according to clinical diagnosis and range of response. Beneath this line *O*'s identification number and sex classification were inserted, *M* representing male and *F* female, respectively. The short cross-bar on each ordinate shows *O*'s mean response to all 'points' in the reel. It is to be remembered that the first reel included only 'points' of a suggestive or erotic nature, while the second reel presented only those of danger and conflict. The means and ranges reported in the previous study on normal individuals are shown by appropriate horizontal lines labeled for identification.

In Fig. 1 we see that in general the diagnostic groups lay within the normal range, the exceptions being three cases for each sex out of 50. One woman just equalled the normal range.

---

[3] The apparatus did not keep the current flowing through *O* constant. *Landis* and *Forbes* (2) have criticized any technique which fails to do this. However, the data all were reported in percentage changes of the actual resistance level and so were precise enough for our purpose.

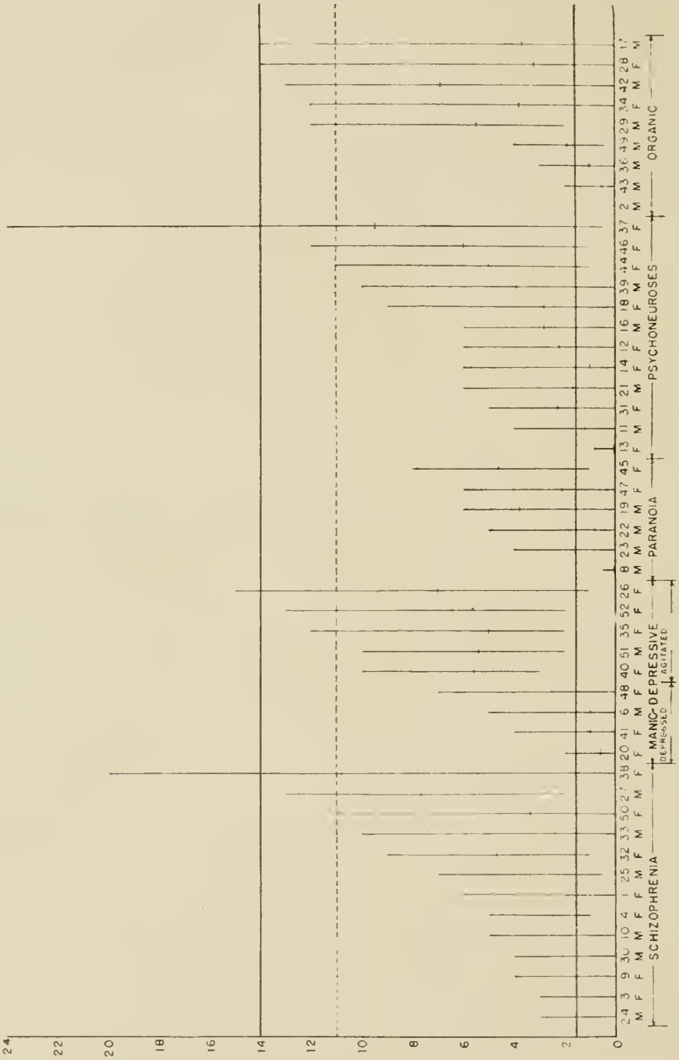


FIG. 1. Summary of comparative data between normal and abnormal *Os* to Reel I

The paranoid group showed the smallest general range, with the exception of the depressed stage of the manic-depressive group. The two stages of the latter group are separated quite markedly in the figure. The range differences are confirmed by the mean values. For the depressed stage the individual means clustered closely around the normal mean, the tendency being to fall below it. In the agitated stage the means were much higher, tending again to cluster. The other disorders varied greatly within themselves, both as to range and mean values. Thus the electrodermal response phenomena seemed to fit the individual more closely than they did any particular designation of the diagnostic group.

In reel II (as shown by Fig. 2) the normal range was exceeded by four women and one man. Ranges generally were smaller in connection with this reel, with several persons not responding at all. The responses here reported were made to 'danger' scenes and it is possible that these were less potent stimuli for abnormal individuals than scenes of the sort studied in Fig. 1. Furthermore, the normal range in response to these 'danger' situations was smaller. The manic-depressive group was not divided into two classes in terms of this reel. No peculiar relation of either ranges or means was shown to particular disorder groups.

Considering both figures, then, we conclude the following:

1. The range of response shown by the abnormal individual was usually well within normal limits. This confirms an earlier finding of *Richter* and *Jung* (6), who used different types of stimuli.

2. Responses were of somewhat greater range in connection with suggestive or erotic scenes than with scenes of danger and conflict.

3. There was little relation between any individual's range or mean and his classification in a diagnostic group, but these data probably were related more directly to the personality itself.

4. There was a tendency for the cases in the manic-depressive group to separate into two classes, depending upon the stage of their disorder. This was seen in Fig. 1. This is a partial confirmation of the work of *Gregor* and *Gorn* (3) who reported a similar tendency, using other stimuli.

IV. Detailed analysis of the data. Certain definite portions or 'points,' somewhat similar to those of *Dysinger* and *Ruckmick* but more numerous, were chosen arbitrarily by *E* and

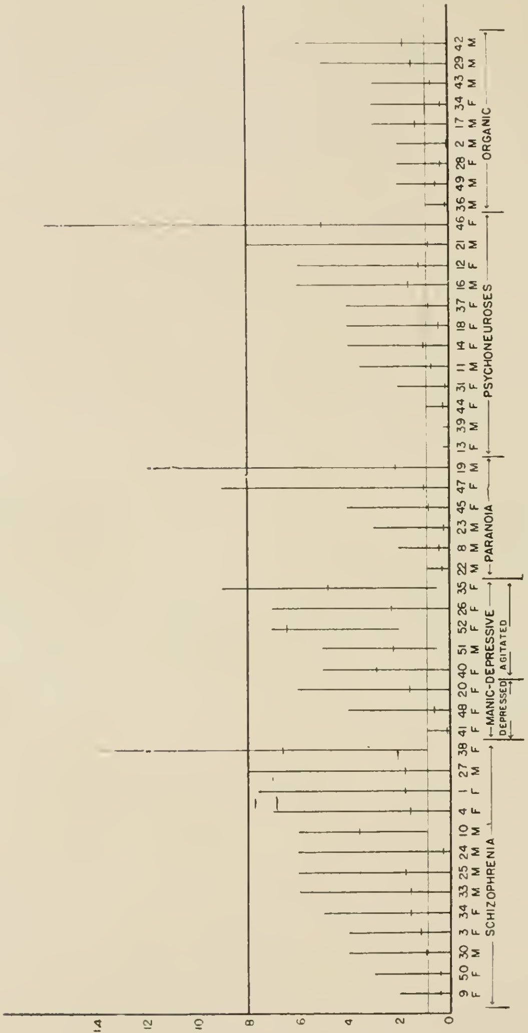


FIG. 2. Summary of comparative data between normal and abnormal *Os* to Reel II

exactly identified on each record. They were chosen because they were, in *E*'s judgment, at the climax of highly affective sections of the picture. The dermal responses, relating to these 'points' were summated under each in percentages. Thus a 'point' would represent the total dermal activity occurring over a small section of the picture. Of these 38 were chosen in the first reel and 40 in the second. For each individual there were thus 78 summations, representing his responses at critical points during the showing of the entire picture. These were plotted and the points joined to form a profile showing the individual's dermal behavior. The result was a condensed picture of the original record, reported in percentages of original dermal resistance. The more detailed analyses were based upon these profiles.

E analyzed each record to observe (1) the sections in each reel to which great responses were shown, (2) the section which elicited a zero or low response, (3) the relative amplitude of all responses as shown by the general level of the profile in relation to the base, (4) the internal consistency of the record, *i.e.*, whether the responses were about equal or fluctuated from very great to very small, and (5) the consistency of the record from the first reel to the second. After the analysis was completed the case records were obtained and the two series of data related.

It was discovered first that there was no relationship between the profile and the designated groups of mental disorder. Individuals in the same group tended to respond in a great variety of ways. In the manic-depressive group, as was shown above in the comparative study, we found that persons in the depressed stage of the disorder tended to have 'flat' profiles ranging near the zero or base line, while those in the alternate stage had profiles of greater range, which averaged above the zero line.

Using this as a point of departure the profiles were studied to see if they were related to the affective report presented by the clinical study. Abundant evidence verified this relationship. In 20 out of 24 cases where the clinical report was of a 'flat,' unemotional sort, the profile was of a 'level' kind. That level was not, however, always near the base line. If the clinical study reported a highly emotional personality, almost without exception the profile was of the fluctuating sort, showing extremes toward zero and maximal responses. These persons responded to the reels of the picture with different ranges, usually showing a much greater response to the first than to the second reel. Others, reported to show only moderate affective responses clinically, had profiles representing a mean between those of the above two groups. We conclude that changes in dermal resistance over a period of time during which various continuous stimuli are brought into play may give a profile which is a fair indication of the individual's affective life.

The study of the greatest responses shown by individuals to various sections of the picture revealed the fact that these responses usually came at a 'point' bearing some relation to the individual's affective difficulties or past history. This occurred so frequently that, in those cases where no relationship was seen, we could conclude that either the individual's difficulty had not been brought to light clinically, or that there was no situation related to it in the presented film. Both of these were quite possible and it is believed that further study using an electrical technique and a variety of presented pictures would yield results valuable to both normal psychology and to clinical diagnosticians.

Only general results have been stated here. The material upon which they were based was so bulky that we include below for illustration only two case studies chosen at random. Supporting material appears in the original protocol.

Case 20. Clinical report: female, age 26 yrs. Diagnosis: depression. She developed the psychosis several months prior to admission, on the basis of early sexual traumata having an incestual coloring. She had continuous thoughts and images of sexual activities with persons representative of the father image and on this basis had developed pronounced feelings of guilt and impending disaster or punishment. Her emotional reactions were slow and 'shallow' and were of even distribution.

Analysis of profile (Fig. 3): she gave the greatest responses during the first reel to an erotic scene and to the scene in which the heroine first received news of her beloved's arrival; in the second reel the greatest responses were made to the destruction of the pagan city by fire and brimstone and to the erotic banquet scene. She answered *E*'s question concerning her impressions of the picture with, " It was all right."

Her level of response on the first reel was low; for the second it was but little higher. This corresponded fairly well with the

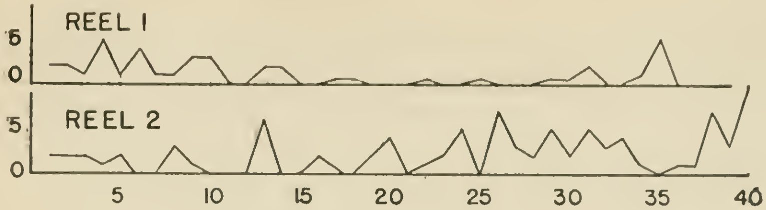


Fig. 3. Profile, Case 20

clinical report. The sense of impending disaster was well shown in her response curve by a rise toward the end of the scenes in connection with the destruction of the city. Other responses bore no obvious relation to the case history.

Case 26. Clinical report: female, age 43 yrs. Diagnosis: agitated depression. Her psychosis originated two years before admission, based on the belief that her husband was drinking and involved in illegal activities with his friends. Subsequently she learned that she was wrong in her accusations and on this basis developed a marked agitation and depression due to feelings of guilt. Throughout her stay in the hospital she showed much tension and restlessness. She was quite disturbed emotionally and shortly after the test she escaped from the hospital and attempted suicide.

Analysis of profile (Fig. 4): Case 26 showed greatest response in the first reel to the scene in which the heroine was urging the hero to worship her goddess. Great responses were made to other parts of this scene as well as to the scene in which the two lovers first meet. In the second reel the greatest response corresponded to the point at which the hero was enticed into dishonest gambling. Other responses to this reel, while usually high, were about equal. She reported later that she did not like the picture very well.

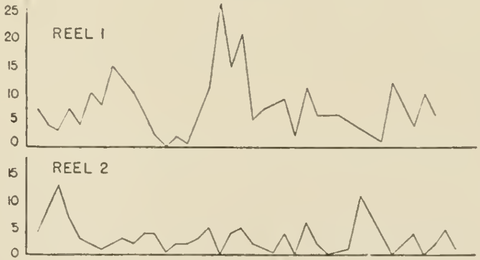


Fig. 4. Profile, Case 26

Her general response was great involving much fluctuation. This was true in both reels, although during the second she was less variable than during the first. The height of affectivity as shown by our study corresponded well to her clinical report. Possibly some connection existed between her response to the gambling escapade and her suspicions concerning her husband.

V. Summary: Growing out of a study of the effects of motion pictures upon the emotional life of children, as measured by the electrodermal response technique, this investigation concerned itself with abnormal *O*s. Improved apparatus made it possible to record all electrodermal changes during a period of continuous stimulation in the form of a two-reel half-hour motion picture. Analysis of these records and comparisons with clinical reports led to the following conclusions:

1. The range of electrodermal responses shown by the abnormal individuals usually fell well within normal limits.
2. Responses to suggestive or erotic scenes were of somewhat greater range than to those of danger and conflict.
3. The mean responses of abnormal individuals approximated normalcy.
4. There was no relationship between types of profiles showing dermal responses and the disorder groups.
5. The manic-depressive group, however, tended to separate itself into subdivisions dependent upon the stage of the disorder.
6. The profiles agreed very well with the clinical analysis of emotional tone.
7. The greatest responses were usually made to a part of the picture bearing some relation to the individual's ' complex.'
8. The two preceding findings indicate that this technique is of value both to normal psychological research and to clinical diagnosis. Situations of different affective constituency may be presented and responses to them may be measured with some degree of accuracy. In the clinic this should be valuable as an aid to diagnosis. In the laboratory it opens an objectively precise approach to study of the affective life.

Bibliography

1. Dysinger, W., and Ruckmick, C. A. The emotional responses of children to motion pictures. N. Y., Macmillan, 1933.
2. Forbes, T. W., and Landis, C. A critique of Crosland's 'Measurement of Emotion,' *Amer. J. Psychol.*, 45, 1933, 522–526.
3. Gregor, A., and Gorn, W. Zur psychopathologischen und klinischen Bedeutung des psychogalvanischen Phänomens, *Zeits. f. d. Ges. Neurol. u. Psychiat.*, 16, 1913, 102.
4. Landis, C., and DeWick, H. N. The electrical phenomena of the skin, *Psychol. Bull.*, 26, 1929, 64–119.
5. Landis, C. Electrical phenomena of the skin, *Psychol. Bull.*, 29, 1932, 693–752.
6. Richter, C., and Jung, C. G. Further investigations on the galvanic phenomenon and the respiration in normal and insane individuals, *Abn. Psychol.*, 2, 1907–8, 215.
7. Ruckmick, C. A., and Patterson, E. A simple nonpolarizing electrode, *Amer. J. Psychol.*, 41, 1929, 120.
8. Ruckmick, C. A. Terminology *in re* psychogalvanic reflex, *Psychol. Rev.*, 40, 1933, 97–98.
9. Wechsler, D. On the measurement of emotional reactions, *Arch. Psychol.*, 12, 1925, No. 76.

DEGENERATION OF EMOTIONAL RESPONSES UPON RESHOWING OF MOTION-PICTURE SITUATIONS

by

Mildred H. Rasmus

I. Introduction. This research is a further experimental study of emotional behavior. The galvanic technique, either with or without other expressive measurements, has been employed throughout this program of investigation of the affective life (*Bayley,* 1; *Dysinger,* 2; *Patterson,* 6; *Smith,* 9). The introduction of motion-picture situations as a means of securing continuous affective stimulation is a new experimental approach. This has already been followed out in two researches (*W. S. Dysinger* and *Ruckmick,* 3; *Greenwald,* 4). The reshowing technique and a method of measurement for it were developed by *D. Dysinger* (2). He used the technique as a test of the validity of studying galvanic responses to motion-picture situations. Much has been learned from studying the phylogenetic and ontogenetic development of emotions; and considerable insight also may be gained from studying the degeneration of emotional response. The suggested approach, noting the degenerative changes in specific emotions, may lead to a new classification of emotions.

After the work of *Bertholon* in 1786, many investigators studied the galvanic skin response. The history of the procedure has been discussed adequately by *Landis* and *De Wick* (5). The degeneration technique—observing 'the wearing out' of an original response—has been utilized by *Ruckmick* (7), in studying degeneration of the consciousness of rhythm when the length of period is increased from 15 sec. up to and beyond one minute.

II. The problem. The aim of this study was to observe differences in intensity of the galvanic skin response to repeated showings of the same motion pictures. The motion pictures were classified in five groups, according to the nature of the situations portrayed. The scenes included situations of amorous love, personal danger, impersonal danger, pseudo-danger of the slapstick nature, and miscellaneous situations which advanced the story but could not be classified in the above groups.

The scenes of 'Hop to It,' Part II, were well adapted to the reshowing technique. Danger or tragedy was realistically presented in many incidents, followed quickly by new turns which relieved the situations of the quality of danger. One would expect that here a decrease in emotion would be concomitant with increasing familiarity. Tragedies in the 'Feast of Ishtar' were final—they were not relieved by further incidents of the story. Degeneration here would result from over-familiarity with the development of, and complete anticipation of, the outcome. We believed that this 'discount' would dampen the emotional response. Further investigation of the degeneration of response to amorous scenes was desired and several of the incidents of the 'Feast of Ishtar' were well-adapted to that purpose.

The following excerpt from *D. Dysinger* (2) was the point of departure for this research:

> "A situation which on first showing seemed dangerous loses some of its emotional intensity when previous observation has given assurance of a happy ending. Such a statement might not be true in the presentation of more profound life tragedies, and it probably is not true in love scenes. Yet it is reported, and it surely would be expected, in the pseudo-tragedies so frequently seen in motion pictures. The fall of a girl from a building, for example, might arouse considerable emotion, but it would not be so intense after one knew that the companion of the girl would run down the steps of the building and catch the girl before she landed. The reshowing validates the technique of the study, not only by showing considerable decreases in the deflection-index, but by showing a surprising consistency in the pattern of response of each individual to the same picture."

III. Experimental procedure. Apparatus. This experiment was conducted in the motion-picture laboratory with the Eastman Kodascope, Model A, and *Wechsler* psychogalvanograph[1] used in the *Dysinger* and *Ruckmick* research. A few modifications were made, such as a new timing device which recorded five-second intervals on a revolving film within the psychogalvanograph. Slow-moving gears had been substituted for the faster ones (*Greenwald*, 4). A second galvanometer for recording pulse-rate and respiration, which had been installed for *Dysinger's* study, was eliminated.

---

[1] C. H. Stoelting Co., general catalogue, No. 24201. A full description with schematic drawing is given in the *Dysinger-Ruckmick* study (3).

Non-polarizing calomel electrodes, which have been described in a previous publication (*Ruckmick* and *Patterson*, 8), were attached so that they protruded below the arm of the chair. The electrodes were modified only to the extent that they were insulated to eliminate a short circuit which occurred when the cotton packing around the glass container and the connecting copper wire became damp if the salt solution was accidentally displaced. The electrode fluid was replenished three times during the experiment in order to keep the salt solution constant.

A control-board with ' stimulus ' and ' movement ' keys made it possible to record on the sensitive paper the occurrence of selected ' reading points,' and all gross movements as well as disturbing outside noises.

Procedure. With minor exceptions, the procedure followed was similar to that adopted by *Dysinger* and *Ruckmick* (3). Since the same films were shown for both researches, the *Dysinger* and *Ruckmick* study served as a preliminary to the planning of this program. In addition, *E* made a preliminary investigation of a group of adults in order to select those situations which would serve as the best ' reading points.' [2] Forty scenes of probable affective value for an adult were arbitrarily selected to be shown. On the basis of these trials, only those situations eliciting the greatest per cent of galvanometric deflection were retained as reading points.

Because more reliable groupings of the scenes were desired, *Dysinger, Ruckmick*, and *E* independently classified the situations. The groupings for this study, as mentioned previously, included scenes of amorous love, personal danger to one of the main characters of the play, impersonal danger to people who had not been identified previously with the story, and pseudo-danger of a ' slap-stick ' nature. Then all scenes having affective value but not easily classifiable in one of the above groupings were designated as being of a miscellaneous nature. Written reports by the *O*s, describing their reaction to the motion picture, were obtained after the showing of each part.

---

[2] The use of a moving stimulus necessitated the adoption of arbitrary ' reading points ' which were kept constant throughout the experimentation.

O was given the following written instructions before the showing of the motion picture:

> "You will be shown two reels of the motion picture, 'Feast of Ishtar,' and one reel of a comedy, 'Hop to it, Bell Hop.' Relax, remaining as quiet as possible, for any gross movement will affect the instrument. Do not talk. After each showing of a film, you will be asked to write how you enjoyed the motion picture, enumerating those scenes which interested you the most."

The index and third fingers were cleaned with 95 per cent ethyl alcohol and bound with adhesive tape beyond the first joint. These two fingers were placed in the liquid electrodes (*Ruckmick* and *Patterson*, 8). The ohmic resistance of *O* was then determined by balancing the Wheatstone bridge. The balancing was complete when there was no variation in resistance for an interval of one minute. The motor of the psychogalvanograph was started and the motion-picture film shown. The only illumination came through a transom.

The *O* was permitted a relaxation between showings, and the Wheatstone bridge was rebalanced before each film. Films were shown in identical order, with 'Hop to It, Bell Hop,' Part I, following Part I and II of the 'Feast of Ishtar.' On the first day, Part I of 'Hop to It, Bell Hop' was shown to give continuity to the story of Part II, but no record was taken.

Reshowing of the motion picture took place on successive alternate days with the time of appointment identical for *O* throughout the experimentation. The schedule of university class-hours determined the alternation of days between showings, as well as the particular time of day. These appointment hours for the 15 *O*s ranged from 8:00 A.M. to 5:00 P.M., with the majority of the *O*s coming during the afternoon.

Classification of 'reading points.' Amorous scenes included the first 13 'reading points' of the 'Feast of Ishtar.' The scenes characterized as 'personal danger' were 2 to 13 inclusive of Part II of the 'Feast of Ishtar,' while the last seven 'reading points' of the same reel were impersonal danger. All situations selected as 'reading points' in 'Hop to It, Bell Hop,' Part II, were characterized by pseudo-danger. The miscellaneous grouping was composed of 'reading points' 14–18, 21 and 22 of Part I, 'Feast of Ishtar,' and 'reading points' 1 and 14–19 of Part II.

Reading the galvanic records. The method of calculating millimetric deflections was that used by *Dysinger* and *Ruckmick* (3) for reading arbitrary points in continuous stimulation. Identification marks, which had been recorded on the sensitive paper as selected affective situations appeared in the motion picture, aided in locating each 'reading point.' A magnifying glass held over the millimetric scale aided in the reading. The amount of deflection was obtained by subtracting the extent of deflection from the extent for the scenes just previous to the selected 'reading point,' with allowance made for the period of latency.

If there had been no change in deflection during this interval of about 15 secs., the reading was recorded as 'zero.' But 'zero' readings were not constant in their significance, for at some times they represented a relative zero and at other times an absolute zero. The latter meant that there had been no change in body resistance from that determined originally by means of the Wheatstone bridge at the beginning of the recording. Relative zero readings often occurred when *O* was responding to a series of scenes of about the same emotional value. The only great decrease in resistance occurred with the initial scene of this sort of series, while subsequent scenes only helped sustain the new electrical conductivity, preventing the return of the galvanometer mirror toward zero. According to the criteria, these readings were interpreted as showing no change in deflection, which made them 'zero' readings. This suggested falsely that no affective response was elicited by the situations. Readings such as these undoubtedly were an important factor in the inconsistent fluctuations which occurred for the same situations with various showings.

The films were read without knowing which showing they represented or what the original resistance was. Each film was read again after an interval of a few days and a comparison made of the readings. Those that showed a discrepancy were given to a disinterested person who decided which reading was the more appropriate.

Unit of measurement. The measurement devised by *Dysinger* and *Ruckmick* (3) for determining the effect of reshowing the motion picture was as follows: the original millimetric measurements of the extent of deflection were transmuted by means of a calibrated scale, on the basis of the original resistance, into per cent of deflection. This made the results comparable for all 'reading points' and for all *O*s. Modifications of the per cent of deflection for a 'reading point' during the various reshowings of the motion picture were obtained by a progressive comparison of each showing with the deflection of the just previous showing. By this procedure, which was designated as Method A, it was possible to calculate the number of times an increase occurred in the per cent of deflection, the number of times there was no change, and the number of times there was a decrease in per cent of deflection. A record of the number of times an increase or decrease occurred would not evaluate the relative size of an increase or decrease. The latter evaluation was obtained by calculating the total amount of increase and the total amount of decrease for each individual point.

Method A was first adopted, but it gave a more exact picture of the fluctuations which occurred than of the various showings as a whole. So, instead of the progressive comparison, a new measurement, Method B, was devised. In it the per cent of deflection from the first showing was used as the standard to which the per cent of deflection for subsequent showings was contrasted. The number of increases, number of 'no changes,' number of decreases, total amount of increases, and total amount of decreases, still were obtained. This was done for each individual 'reading point.'

To show what occurred during the various scenes, scores at each 'reading point' were summated for each classification. An estimate of what occurred for all *O*s was made by consolidating the scores within the five classifications. This gave the total number of times for all *O*s that an increased deflection, an identical deflection, and a decreased deflection occurred, and also the total extent of increases and decreases for the scene classification. The data were completely treated throughout this procedure by both Methods A and B, but final interpretations were based on Method B.

Observers. An unselected group of 15 elementary psychology students served as *O*s. Although they ranged from 19 to 26 years in age, the majority of them were of sophomore ranking. Their percentile ratings on the *University of Iowa Qualifying Examination* suggested that they were of more than average intelligence, with four of them ranking at the 90th percentile. On the basis of scores on the *Thurstone Personality Schedule,* the group as a whole could be described as well-adjusted individuals. They have been designated throughout the tables by the first 15 letters of the alphabet.

TABLE I. *Responses to love scenes, scored by Method A*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	20	22	23	56	56
B	19	9	35	58	90
C	34	30	34	68	69
D	21	36	23	26	49
E	24	8	38	42	69
F	20	9	27	45	76
G	16	6	32	53	145
H	26	14	25	52	61
I	44	33	56	88	99
J	30	35	33	82	91
K	13	9	29	33	75
L	34	29	41	59	68
M	24	34	29	53	51
N	17	15	22	30	45
O	14	26	34	34	78
Total	356	315	481	779	1122
Av. per *O*	23.73	21.0	32.07	41.93	74.8

IV. Discussion of results. Amorous love scenes. Computed by Method A, Table I suggests that in response to love scenes the majority of *O*s showed about as many increases as decreases, with 10 *O*s having a large number of ' similar ' deflections. All but four *O*s showed a significant amount of decrease compared to the amount of increase; three showed a small preponderance of decreases. The only *O* (M) who did not show this tendency had 53 per cent of increase and 51 of decrease, which, however, was not a significant difference. When scores of 15 *O*s are combined the same tendency is shown. The average number of 'decreases,' 'equals,' and 'increases' was respectively 32.07, 21.0, and 27.73 per *O*. A comparison of total amounts of per cent increase and decrease again suggests a significant amount of decrease. The average for each *O* was 74.8 per cent decreased deflection; the average per cent of increased deflection was 41.93.

TABLE II. *Responses to love scenes, scored by Method B*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	16	9	40	44	50
B	13	7	43	48	105
C	43	35	20	87	27
D	30	31	19	31	138
E	15	10	45	24	88
F	20	10	26	47	74
G	3	1	50	12	288
H	16	17	32	39	70
I	39	20	74	63	172
J	26	26	44	71	102
K	4	1	46	7	229
L	39	36	29	66	36
M	45	26	16	79	18
N	17	10	27	28	78
O	11	10	54	32	159
Total	337	249	565	678	1634
Av. per *O*	22.46	16.6	37.66	45.2	108.93

Since Method A was unduly influenced by fluctuations, Method B was used, with the same general trend again evident in all respects, although there was a much more significant amount of decrease. The average number of decreases was 37.66, the average number of identical responses, 16.6; and average number of increases, 22.46. The average decrease in per cent of deflection was 108.93 while the average increase in per cent of deflection was 45.2 for each *O*. For this group as a whole the amount of decrease was 2.41 times the amount of increase.

Personal danger scenes. Table III, obtained by Method A, suggests that though there was a tendency toward decreased deflection it was too slight to be significant. About half the *O*s showed an increase more often than they did a decrease. When scores of all *O*s were combined the average number of decreases was 21.87, of identical responses, 20.13, and of increases, 18.53. Except for C and H there was a slight tendency to show a greater

TABLE III. *Responses to personal danger scenes, scored by Method A*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	16	13	18	32	35
B	9	16	21	22	49
C	23	19	21	46	41
D	13	29	17	14	18
E	20	16	24	88	102
F	16	8	12	40	58
G	25	15	29	67	82
H	22	9	17	39	34
I	33	26	42	74	87
J	25	31	27	42	42
K	13	14	19	44	63
L	28	24	32	61	77
M	10	39	10	10	11
N	13	16	18	20	26
O	12	27	21	21	43
Total	278	302	328	620	768
Av. per *O*	18.53	20.13	21.87	41.33	51.2

TABLE IV. *Responses to personal danger scenes, scored by Method B*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	13	19	15	26	28
B	8	13	25	20	104
C	36	27	0	61	0
D	5	29	25	5	25
E	14	18	28	69	38
F	18	5	13	47	78
G	16	11	42	37	162
H	22	15	11	37	11
I	17	20	64	42	111
J	26	34	23	48	65
K	5	2	39	20	157
L	13	8	63	40	100
M	17	35	7	17	7
N	13	16	18	19	25
O	6	15	39	12	113
Total	229	267	412	500	1024
Av. per *O*	15.26	17.8	27.46	33.33	68.

amount of decrease than increase, yet not a particularly significant one. The contrast between average amounts of these showed this trend more clearly. The average increase in per cent of deflection for each *O* was 41.33; the average decrease was 51.2. When computations were made by Method B, which was not so dependent upon fluctuations, a more significant trend of decrease is discerned. The average number of decreases was 27.46 for each *O*, the average number of equals, 17.8, and the average number of increases was 15.26. This indicated a rather significant preponderance of decreased deflections. The average amounts of decreased and increased per cent of deflection for each *O* were 68.0 and 33.33 respectively. For the group as a whole the amount of decrease was 2.04 times the amount of increase.

TABLE V. *Response to impersonal danger scenes, scored by Method A*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	9	14	6	30	23
B	4	16	10	6	16
C	11	21	13	21	23
D	10	16	11	13	16
E	12	12	16	31	38
F	11	2	9	17	17
G	15	7	21	41	63
H	12	23	9	16	10
I	9	7	8	16	21
J	14	18	13	15	15
K	10	8	13	49	39
L	12	16	13	29	32
M	6	10	4	6	4
N	6	15	11	8	13
O	2	21	9	6	21
Total	143	206	166	304	351
Av. per *O*	9.53	13.73	11.11	20.27	23.4

Impersonal danger scenes. Table V, computed by Method A, shows a consistent and slight tendency toward a smaller number of decreases and a smaller per cent of deflection. More than half of the *O*s showed this decrease in all respects. The average frequency of increases was 9.53, of equals, 13.73, of decreases, 11.11. The average amount of increase in deflection was 20.27; the average decrease was 23.4.

The computations of Method B, Table VI, substantiate the trend manifested by the first measurement, except that a more significant tendency towards a decreased response was shown.

Table VI. *Response to impersonal danger scenes, scored by Method B*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	13	13	3	34	3
B	5	7	18	8	27
C	9	22	14	18	17
D	9	13	15	11	25
E	8	12	20	27	23
F	13	5	4	16	8
G	6	4	33	12	140
H	8	5	10	13	35
I	20	21	3	25	3
J	14	22	9	16	12
K	9	2	20	31	55
L	12	16	13	32	13
M	5	12	3	5	3
N	8	10	14	9	18
O	2	6	24	6	59
Total	141	170	203	263	441
Av. per *O*	9.4	11.33	13.53	17.53	29.4

Table VII. *Responses to pseudo-danger scenes, scored by Method A*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	7	15	24	9	97
B	3	21	10	6	20
C	15	30	25	26	67
D	7	23	6	9	9
E	2	14	17	3	82
F	..	..	..	..	..
G	33	9	34	87	100
H	26	14	28	61	70
I	31	20	34	59	67
J	3	13	5	4	8
K	4	16	28	10	86
L	18	10	45	34	128
M	14	13	20	31	42
N	6	14	14	6	96
O	..	..	..	..	..
Total	169	212	290	345	872
Av. per *O*	13.0	16.31	22.31	26.54	67.08

Over half the *O*s, considered individually, showed a significant trend toward decreases both in number of times and in amount of deflection. There was an average frequency of decrease of 13.53, of identical amount of deflection, 11.33 per *O*, and of increase, 9.4 times for each *O*. With the scores combined for the group there was average amount of decrease of 29.4, contrasted with 17.53, the average amount of increase. For all *O*s the amount of increase was 1.67 times the amount of increase.

Comedy or pseudo-danger scenes. The data computed by means of Method A, Table VII, indicated that all but three *O*s showed a greater number of decreases than increases. The average number of decreases was 22.31, of identical responses 16.31, of increases, 13.0. The average amount of decrease was 67.08 for each *O*, the average per cent of increase, 26.54. Again, as with the other types of scenes, there was this consistent and significant tendency for more decreases than increases to occur.

TABLE VIII. *Responses to pseudo-danger scenes, scored by Method B*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	2	9	37	3	172
B	3	19	12	5	19
C	6	18	47	6	161
D	9	19	9	10	15
E	2	11	20	3	92
F	..	..	..	..	..
G	18	7	51	57	166
H	40	6	22	81	87
I	34	31	20	59	26
J	3	13	5	4	8
K	2	5	41	7	147
L	7	5	60	14	262
M	16	8	23	31	34
N	5	12	17	8	108
O	..	..	..	..	..
Total	147	163	364	288	1297
Av. per *O*	11.3	12.5	28.0	22.2	99.9

Table VIII shows the application of Method B to the data. It indicates that all the *O*s but two gave a significant decrease in the number of times a decrease occurred. The average frequency of decreases was 28.0, of equals, 12.5, and of increases, 11.3. For all *O*s but one there was a larger amount of decrease than increase. With the scores consolidated for the group, the average amount of decrease was 99.9, and the average amount of increased deflection was 22.2. For all *O*s the amount of decrease was 4.50 times the amount of increase.

Miscellaneous. In this grouping the general tendency for a decrease in all respects was noticed, as shown in Table IX. When the *O*s were considered individually, the majority of them showed a small decrease in per cent of deflection and also a small decrease in the amount of deflection. The average frequencies of decrease, equal, and increase were 25.93, 22.07, and 22.5, respectively. The average amount of decrease was 55.47; the average amount of increase was 46.0.

TABLE IX. *Responses to miscellaneous scenes, scored by Method A*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	17	22	21	37	37
B	12	17	26	23	42
C	28	43	19	43	32
D	19	28	27	27	48
E	21	19	30	73	91
F	19	4	24	45	83
G	25	16	28	53	71
H	26	15	20	53	40
I	39	29	37	76	71
J	26	38	31	53	67
K	21	14	19	66	55
L	35	15	40	59	66
M	16	28	18	29	31
N	17	18	20	23	30
O	17	25	29	30	68
Total	338	331	389	690	832
Av. per *O*	22.5	22.07	25.93	46.0	55.47

In Table X, where Method B was applied to the data, a more definite trend towards degeneration is evident. The majority of *O*s, considered individually, showed a tendency for decrease in reflection to occur more often than an increase; this also was true for the total amount of decrease. The average frequencies of decrease, equals, and increase were 29.5, 21.0, and 20.0, respectively. The average amount of increase was 42.0; the average amount of decrease was 69.2. For the *O*s as a whole the amount of decrease was 1.64 times the amount of increase.

'Curves' of degeneration. The original table containing the per cent of deflections for each reading point suggested to *E* that, although upon reshowing there were numerous situations eliciting a steady regression in emotional response, the more usual 'curve' of degeneration was characterized by fluctuations. To determine if this was normal for the various situations, Method C was

applied. This method was based upon the total percentages of deflections for the five types of situations in repeated showings. The average deflection for each scene for the various showings of each *O* then was secured. On the basis of these it was possible to observe how steady or fluctuating was the tendency toward degeneration. These combined data substantiated the observation made upon the individual 'reading points.' Some *O*s showed a steady, progressive decrease in emotional response with each reshowing. This was illustrated by N, whose combined average deflection for the love scenes decreased from 2.3 per cent of deflection for the first showing, to 2.07, 1.71, 0.31, and 0.47 per cent of deflection for successive reshowings. Though there were *O*s who gave this progressive decrease, the usual degeneration was more like the data from E. For the first showing of the love scenes his average deflection was 2.50, followed by 1.64, 1.71, 1.28, 2.71, and 0.29 for the reshowings. His written reports showed that this occasional fluctuation was the result of a reawakening interest in character interplay, or of refocusing attention.

TABLE X. *Responses to miscellaneous scenes, scored by Method B*

Observer	No. increases	No. equals	No. decreases	Total increase	Total decrease
A	17	17	26	33	42
B	14	11	30	23	54
C	36	49	5	55	5
D	11	24	39	15	112
E	17	22	31	68	67
F	12	9	26	37	95
G	13	14	42	37	123
H	35	21	5	68	6
I	24	27	54	55	109
J	23	36	37	41	79
K	16	8	29	49	86
L	42	26	22	76	31
M	21	22	19	39	23
N	13	18	25	18	37
O	6	11	53	16	169
Total	300	315	443	630	1038
Av. per *O*	20.0	21.0	29.5	42.0	69.2

V. Discussion. Interpretation of the data was based upon the extent of galvanic deflection and the commentaries given by the *O*s as to their enjoyment of each film.

Diminution of response was greatest in the scenes of pseudo-danger of a 'slap-stick' nature. The suggested reason for this abrupt decrease in per cent of deflection upon reshowing, as evidenced by the commentaries, was as follows: the comedy situations of danger depended upon the element of unexpectedness; when this was gone there was nothing left to stimulate attention. The paucity of detail in acting and development of character, the lack of interplay between characters, and the absence of interest in the actors as real people gave the *O*s no motivation to maintain interest. Some brief quotations from the comments made by D illustrate this. "The comedy was fun," was the summary of his interest in the first showing. But after the second showing he reported, "I nearly went to sleep; all surprise was gone so it couldn't seem very funny."

It was to be expected that the greatest decrease in affective value would occur in these scenes of pseudo-danger, where the outcome of the situation was the paramount factor. Likewise in these artificial scenes, so unlike the real happenings of life, the 'adult discount' was prevalent for all *O*s. The usual comments upon the reshowing were, "Generally silly and ridiculous; it was impossible; no intelligence was shown."

The remaining four types of situations, amorous love, personal danger, impersonal danger, and miscellaneous, were all events in the story of the 'Feast of Ishtar.' The response to impersonal danger scenes was negligible. In fact many *O*s registered only a slight deflection, which can be interpreted as a slight emotional response. The impersonality of the scenes of destruction and flight from the burning city did not attract or hold attention. Because of the preponderance of 'zero' readings from the beginning, there could not be as large a decrease in emotional response. The comments of the *O*s suggested that even the spectacular element was rather ineffectual when it pertained to impersonal scenes where the identity of the character was unknown.

In regard to the amount of emotional response to the three remaining types of situations, the difference between any two of the three was not as great as that existing between the situations of a pseudo-danger nature and other scenes. There was more to watch, more to hold the attention, and the situation was not of paramount importance, as in 'slap-stick' comedy. When the characters and their problems ceased to hold the attention of the *Os*, when they knew the resolution of the crisis, there still was richness of detail in the background, revelation of character, finesse of acting, and interpretation of motive to sustain the affective value.

It was assumed that a degenerative response would more easily result during stimulation by personal danger scenes than it would during stimulation by love scenes. But the results of this research, on the basis of Method B, which was accepted by *E* as the better method, showed no significant difference. Comments of the *Os* suggested that the action and wealth of detail from interplay of character in the gambling scenes continued to have affective value longer than the amorous scenes, although the original deflections had not been as large.

The influence of 'adult discount' was not as great in these three types of situations. *Os* mentioned the artificiality of the destruction of the city in the impersonal danger scenes, saying they knew it was done only with small clay models. But there was more interpretation of character interplay, with new perceptual relationships seen in the other three types of scenes. As *N* said, "I enjoyed the scene where Tisha succeeds in converting Jether to her goddess, Satar. It seemed significant to me because it symbolized the weakness of man, his inability to maintain his ideals where women are concerned." Again this *O* remarked, "I enjoyed the destruction of the city because the punishment meted out to the pagans seemed just to me, and it in a sense compensated for the injury of Jether."

The responses to the miscellaneous scenes, those establishing character, developing the plot, and setting up the inter-relationships between characters, did not show as much degeneration as either the love or personal danger scenes, but were characterized by a uniform tendency toward degeneration of the galvanic records. This tendency and the comments for the five types of scenes, suggest the conclusion that a degeneration in emotional response occurred with the reshowing of motion-picture situations.

IV. Conclusions.

1. A degeneration in emotional response tended to occur with the reshowing of motion picture situations having affective value,

although fluctuations often occurred in the form of a temporary increase in emotional reaction.

2. Individual differences were present in the number of reshowings needed to degenerate the emotional response to these five types of situations.

3. There was, for all scenes, a definite tendency for reshowings to elicit decreased, rather than increased, emotional response.

4. Diminution of response was greatest in scenes of pseudo-danger. The amount of decrease was 4.1 times the amount of increase.

5. The decrease for the amorous and personal danger scenes was approximately half that obtained in pseudo-danger.

6. Impersonal danger and miscellaneous scenes elicited less emotional intensity on the initial showing, with consequent slighter degeneration during reshowings.

7. Pseudo-danger situations produced the greatest original deflections and the most rapid and consistent degeneration of the five types of scenes studied.

8. Commentaries from the *O*s indicated that increased familiarity lessened the affective value of the situations.

9. These reports suggested also the presence of an 'adult discount,' especially for scenes of pseudo-danger, and a tendency for the *O*s to observe finer details with each showing.

Bibliography

1. Bayley, N. A study of fear by means of the psychogalvanic technique, *Psychol. Monog.*, 37, 1928, No. 4, 1–38.
2. Dysinger, D. W. The comparative study of affective responses by means of the impressive and expressive methods, *Psychol. Monog.*, 41, 1931, No. 4, 14–31.
3. Dysinger, W. S., and Ruckmick, C. A. Emotional responses of children to the motion picture situation. N. Y., Macmillan, 1933.
4. Greenwald, D. U. Electrodermal responses of abnormal individuals (this volume, pp. 28–39).
5. Landis, D., and DeWick, H. The electrical phenomena of the skin, *Psychol. Bull.*, 26, 1929, 64–119.
6. Patterson, E. A qualitative and quantitative study of the emotion of surprise, *Psychol. Monog.*, 40, 1930, No. 1, 85–108.
7. Ruckmick, C. A. The rôle of kinaesthesis in the perception of rhythm, *Amer. J. Psychol.*, 24, 1913, 305–359.
8. Ruckmick, C. A., and Patterson, E. A simple non-polarizing electrode. *Amer. J. Psychol.*, 41, 1929, 120–121.
9. Smith, F. Variations in the galvanic response, *Psychol. Monog.*, 41, 1931, No. 4, 142–152.

THE EFFECT OF MOVEMENT ON THE ELECTRODERMAL RESPONSE

by

BENJAMIN SCHAEFER

1. Introduction. Among the problems involved in the use of the electrodermal response technique, two are of fundamental importance. The first problem is to determine the effect of movement on the recorded response. The second is to determine the characteristics of the recorded response in order to enable *E* to distinguish responses due to movements from those due to emotional factors. It is the purpose of the present study to present experimental data which, it is hoped, will contribute at least to a partial solution of the stated problems.

Complete elimination of all movement during an experiment is practically impossible. Therefore it is important that *E* know as definitely as possible what effects movements may have on the response records in question. Gross bodily movement can be controlled, but the effect of relatively simple movements should be known. *Davis* (3) expresses the need for further experimentation when he says, "With the wide variability in the reflex the most necessary contribution to knowledge of the reflex seems to be the discovery of more participating factors which can be controlled experimentally." It is not necessary to review the history of the psychogalvanic reflex, more appropriately termed by *Ruckmick* (11) the electrodermal response. The most complete recent review of these investigations has been published by *Landis* (8).

Du Bois-Reymond in 1843 called attention to the fact that muscle contraction causes a galvanometric deflection. For many years experiments have been conducted, using the methods of both *Féré* and *Tarchanoff*, without particular attention being paid to simple muscular movements. *Waller* (13) noticed that raising the little finger caused a momentary increase of resistance but he did not believe that movement affected the ' psychogalvanic reflex ' to an appreciable degree. *Jeffress* (7) ascertained how movement and other irrelevant activity of *O* may affect the galvanometric record. He concluded that gross bodily movement had practically no effect unless accompanied by a conspicuously strong tension of the arm muscles. Usually, too, such a movement resulted in a curve of irregular shape, quite different from the characteristic curve of the psychogalvanic reflex. *White* (15) compared electrical resistance during relaxation with resistance during bodily tension. He used a dynamometer to produce one type of tension and voluntary bodily tension for another type. He found that electrical resistance is greater during relaxation than during tension. This finding agrees with *Richter's* (9), that resistance increases during sleep.

Decrease of bodily resistance during fatigue has been reported by *Ruckmick* (10). Resistance was consistently lowered when the right arm was held outstretched as long as possible in a horizontal position.

The usual method resorted to in former experiments, to eliminate the possible effect of bodily movement, as mentioned by *Dysinger* and *Ruckmick* (4), has been to observe or have *O* report when movements were made. If possible a note was made of such movements and the deflection recorded at that time was not considered. This is not a very desirable method because the moment when a movement is made can not always be recorded satisfactorily.

II. Apparatus. Investigators using the electrodermal response technique have found certain characteristics desirable in an apparatus. The essential requirements are: (1) measurement in standard physical units; (2) continuous measurement; (3) permanent record of all variations; (4) constant visibility of resistance level and variations in response; (5) simple, preferably dry, electrodes; (6) as constant a current as possible through *O*; and (7) minimal polarization.

The electrical circuit here used to meet the above requirements was devised in the psychological laboratories at the University of Iowa. A complete description of the circuit and apparatus is given by *Greenwald* (6). Essentially, the 60~, 110 v. alternating current supply was reduced in potential by a transformer to an output of 15 v. *O* was placed in series with the 15 v. A.C. supply, a rectifier, the galvanometer, and a variable resistance. This variable resistance was adjusted so that the total resistance in the circuit, including that of *O*, was 135,000 ohms at the beginning of the experiment. The galvanometer needle was set at a definite point by sending a second current through the galvanometer in the opposite direction.

The resistance was composed of a number of fixed resistors thrown into the circuit by means of a 10-tap, shorting-type, rotary switch. The values of these resistances were such that for an *O*'s resistance of 15,000 ohms and each multiple of that resistance, up to eight, exactly 135,000 ohms were placed in the transformer's secondary circuit. The resistance of *O* plus the fixed resistance always approximated 135,000 ohms.

The resistance of the rectifier to an alternating current proved to be negligible. The galvanometer used had a sensitivity of 0.13 micro-amperes per mm. scale deflection, and with the proper 'bucking' current gave a full scale deflection for a 15,000 ohm drop in *O*'s resistance. It was possible to detect changes as slight as 300 ohms in dermal response, at any resistance level within the range of the apparatus.

The apparatus was calibrated by putting a precision resistance-box in place of *O*. The resistance was set at 15,000 ohms, and the rotary switch turned to the first position. The deflection was then noted. A calibration curve for the first position was drawn, with the scale readings along the abscissa and the corresponding ohmages, in place of *O*, upon the ordinates. A similar curve was constructed for each of the eight positions. They were found to be nearly linear.

The original *Wechsler* (14) psychogalvanograph was used to record deflections. The apparatus had been adapted to use 3⅜ in. Eastman No. 1 sensitized paper. The front of the camera contains a translucent scale, upon which is reflected a beam of light from a small concave mirror mounted on the recording instrument. This beam is focused through a narrow slit upon the sensitized paper and at the same time on the scale for observational purposes. A timing device attached to the roller which moved the recording paper made time lines at intervals of two seconds.

Dry copper electrodes, 2.5 cm. square, designed and described by *Ruckmick* (12), were used. An alternating current passing through *O* minimized the effect of polarization.

III. Observers. The *O*s for this study were selected at random from students at the University of Iowa. It was considered advisable not to have a 'select' group but one as nearly representative as possible of the university population. Each *O* was briefly told the nature of the study and asked if he would be willing to serve for about an hour. Those who seemed nervous, apprehensive, or unwilling were not accepted, because their records obviously would be of an emotional character during at least a part of the experiment.

The records of 32 *O*s, 14 men and 18 women, were used in the compilation of the data. Records of all movements for each *O* were desired for purposes of comparison. Several deflections of five *O*s were too near the ends of the scale and consequently not completely recorded. None of these five records was used.

IV. Procedure and technique. The movements selected were for the most part those that might be normally elicited during an experiment using the electrodermal technique. The voluntary movements of the arm were confined to the right arm because the electrodes were attached to the left hand and it was motionless.

During preliminary work the order of movements was varied but no difference was noted which could not be explained by the usual individual change in resistance during the experiment. Magnitude of deflection for a movement was very much the same, providing that the dynamometer tension was last in the series and that a rest period of at least a minute was taken between each pair of movements. This was necessary because fatigue resulted from gripping the dynamometer for a short period.

On the basis of a comprehensive study of fear, *Bayley* (1) definitely considers startle a typical emotion. For purposes of comparison in this study, the startle from a whistle stimulus was used as a typical emotion response for each *O*. The situations used in the study consist of one emotion and 10 movements. The situations were as follows:

1. Hand from knee down to side and return. Place your right hand on your right knee. By the second count have it in a vertical position down at your side, then return it to your knee by the third count.
2. Hand to forehead and return. By the second count raise your right hand from your right knee to your forehead in the form of a salute and return it to your knee by the third count.
3. Swinging arm. Beginning with your hand on your right knee, lower your hand to your side until your arm is in a vertical position. Then swing it forward level with your knee and then backward to a vertical position. Make a swing forward during one count and backward the same speed. Return your hand to your knee by the sixth count.
4. Sigh. Sigh normally as though you were tired.
5. Clear your throat. Do not exaggerate the action.
6. Cross your knee and return. By the second count cross your right knee over the left. Begin returning the right foot to the floor by the third count and place the foot on the floor by the fourth count.
7. Deep breath. Take as deep a breath as possible and hold it until told to exhale then exhale completely. Time of holding, five sec.
8. Passive movement—lift and drop. Be as relaxed as possible. Let your arm hang at your side completely relaxed. By means of a strap loosely fastened around your wrist, *E* will lift your hand by means of a cord and pulley on this apparatus stand. Your hand will be lifted level with the top of your head, then allowed to drop. Allow it to fall limply at your side. Your hand will not be hurt.
9. Passive movement—lift and lower. Be completely relaxed as in the other passive movement. *E* will merely raise and lower your arm. Do not use your muscles in any way.
10. Dynamometer. When *E* says 'squeeze,' grip the dynamometer as tightly as possible and hold it until told to release it. Do not be interested in how much you can grip it so long as it is as much as you can do. Do not move the rest of your body. Time for holding, five sec.
11. Whistle—startle. This was given without *O*'s knowledge of it. It was given at the end of the experiment and after *O* was told to relax so that a record might be taken of a change of total resistance during the experiment. This was true but the whistle produced a startle which was used for purposes of comparison between it and the movements.

Another situation was used to show whether imagination would be accompanied or followed by an electrodermal response. The directions for this were:

Imagine that a hair is irritating you on your forehead and that you wish to brush it aside. However, make no movement. You will be told when to start imagining and when to stop. Time, 10 sec.

If any change in resistance was noted during this 'imaginal' situation it was slight, as shown by the curve for 'imagining' (Fig. 1). The slight changes recorded were attributed to the normal change of total resistance taking place during an experiment along with, and independent of, the deflections due to the controlled situations. The records for imagination were not included in the treatment of the data.

It will be noted that not all movements are distinctly different. Movement No. 3 may be considered a variation or prolongation of one, No. 7 an exaggeration of No. 4, and No. 8 and No. 9 are closely related. We desired to determine whether characteristic differentiæ in variations of similar movements could be noted in the curve of response.

The *O*s were seated in a chair in full view of *E* but so placed that the *O*s were not distracted by *E*'s manipulating the apparatus. The chair was provided with a left arm rest, comfortably softened with cloth. Two straps fastened to the rest held the forearm securely and prevented its being moved.

Before the arm was fastened and the electrodes attached, the following directions were read by *O*:

Directions for O. This experiment is an attempt to determine the effect of movement on galvanometric reading.

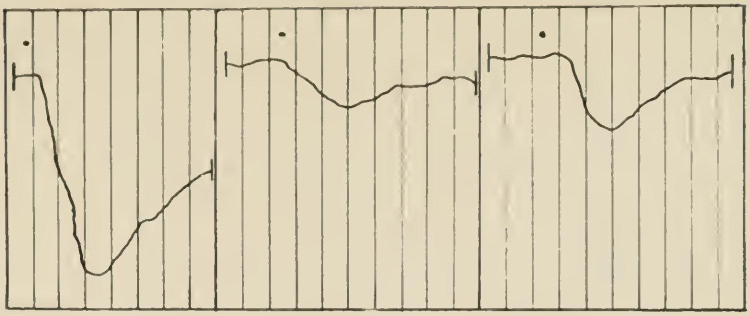
It is necessary that you eliminate all emotional feelings and ideas. Briefly, make your mind as 'blank' or free from all mental processes as possible. Do not so much as wonder what will take place next in the experiment as you will be told each step in advance. Be as relaxed as possible both mentally and physically.

The electrodes placed on your left hand will not give you a shock nor irritate your hand. Your arm is to be as firmly fastened as possible to avoid movement of the left hand. You are asked not to move your left hand or fingers of the hand. However, do not tense them. Keep the palm upward as much as is possible. Assume a comfortable position.

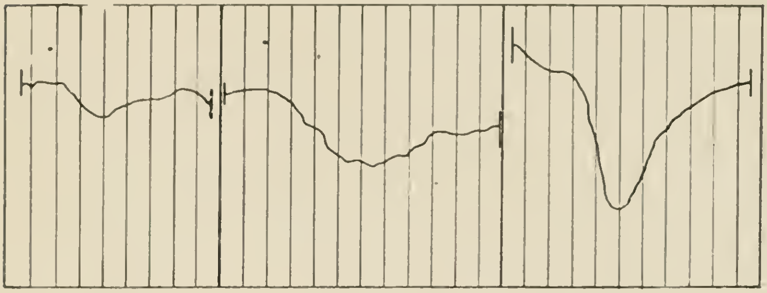
You will be asked to make various simple movements with your right hand and arm, such as dropping it to your side, swinging it at your side at a given speed, raising your hand to your forehead as in a salute, to allow the experimenter to move your arm while it is relaxed, and similar movements. Other situations will be to sigh, and to 'clear your throat.'

While you are making any one movement please avoid making any other movements with your body. Please keep both feet flat on the floor throughout the experiment.

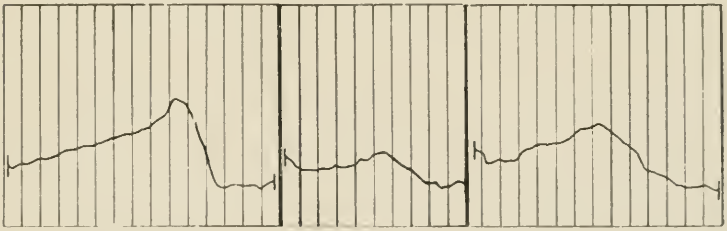
The experimenter will tell you each movement you are to make and after a brief pause will tell you to make the movement. After each movement you are to remain as quiet as possible. Do not be expectant of signals or what will take



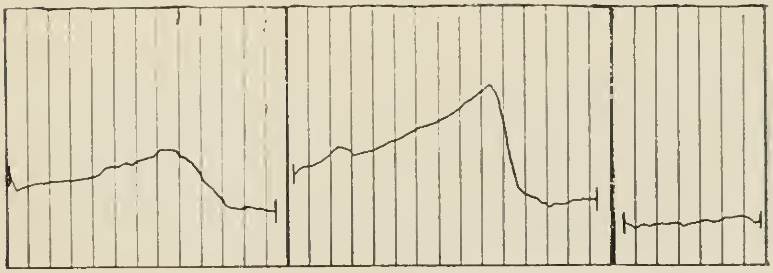
1. Hand to side 2. Hand to forehead 3. Arm swinging



4. Sigh 5. Clearing throat 6. Crossing knee



7. Deep breath 9. Passive movement 12. Imagining



8. Passive movement 10. Dynamometer 11. Startle

FIG. 1. Tracings of typical electrodermal response records

place next. The more closely you follow these directions, the less time will be required to complete the experiment. Do not talk unless asked to do so by the experimenter or unless you do not understand the movement you are to make.

O's left palm then was cleaned with a 95 per cent solution of ethyl alcohol, to remove any foreign matter which might prevent accurate registering of the electrodermal response. The palm was dried with cotton. *O* was again assured that no shock would be given and no uncomfortable effects noticed during or after the experiment.

The electrodes referred to above also were cleaned and dried in the same manner as *O*'s palm. They were fastened to the palm of the left hand. After *O* had been put in the circuit, the palm was turned upward and then downward to determine whether the electrodes had been placed firmly against the skin. When practically no deflection was registered while the palm was in one position or the other, the electrodes were considered well adjusted. However, *O* was required to keep the palm upward while the arm was maintained in a comfortable position. The two straps of the arm rest were tightened to keep the forearm from moving. One was near the elbow and the other over the wrist, but they were not tight enough to hamper blood circulation.

All the movements except the dynamometer grip were practised by *O* to avoid a variation of movements between different individuals in response to the same directions. Each movement was first described, then demonstrated. The 'count' or speed of movement was determined by a metronome set at one beat per second. Most *O*s were able to judge the speed of the movements accurately enough to dispense with the metronome beat during the recording. The possible distracting effect of the beating metronome thus was eliminated after the practice movements.

O was asked if he had any questions concerning the procedure before photographic records were made. *E* then asked *O* to be as relaxed as possible and to feel no apprehension or interest during the experiment other than carrying out the directions.

A record was made of *O*'s resistance at the beginning of the experiment. *E* described each movement before it was to be made, to avoid uncertainty and confusion. The time between the direction and the signal 'now,' when the movement began, varied because the movement was made only when no visible change was registered by the galvanometer.

The time that the record was continued for each movement after the maximal decrease was not the same in all cases. The deflection seldom returned exactly to the level from which it had departed before the movement began, and the duration of the period of recovery therefore depended upon how soon the galvanometer registered no change of resistance. A stimulus-key recorded the beginning of a movement.

After the recording, *O* was asked the following two questions:

1. What was your attitude toward being an observer for the experiment?
2. What was your attitude or feeling during the experiment?

Typical replies to the first question were as follows:

1. "I was somewhat interested and wanted to know what the experiment was like."
2. "I was tired of studying and was glad to have a change."
3. "I wondered what I would have to do and was a little hesitant to be an observer."

Typical replies to the second question were of greater importance and were more or less of the following nature:

1. "I was casually interested during the practice period but after that I knew what I was to do so I just tried to follow directions."
2. "I didn't care what was done. I felt rested until the dynamometer and whistle were used."
3. "Sometimes I was expectant but took the attitude of not caring. I was pretty indifferent after the practice."

V. Analysis of the data. Method of treatment. The deflections of the galvanometer were read from the photographic records in terms of millimeters. These readings were then transmuted into ohms from the calibrated curves referred to in the discussion of apparatus.

Explanations of the terms used and how they were derived are given below.

The *period of latency* is the number of seconds elapsing between the stimulus mark on the record and the beginning of the change in resistance shown by a rise in the response curve.

The *period of deflection* is the number of seconds from the beginning of the deflection to the peak or maximum change in resistance recorded.

Percentage decrease in resistance. The resistance in ohms at the beginning of each situation, and the resistance at the maximum point of deflection (peak) were found. The quotient found by dividing the difference between these two readings by the resistance at the beginning of each situation, was called the percentage change or decrease in resistance for each movement.

Percentage recovery of resistance. The recovery phase is that part of the response curve following the peak of deflection. The only part of the recovery phase considered in this study was that having a period of duration equal to the period of deflection. The difference in ohms was obtained between the reading at the peak of deflection and the point terminating the recovery phase considered. The deflection in ohms was called the percentage of recovery of resistance. This was a percentage of the total deflection for each situation.

TABLE I. *Periods of latency and periods of deflection of men and women in seconds*

	1		2		3		4		5		6		7		8		9		10		(11)	
*O*s	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D
1	0	5	2	4	3	6	0	6	2	4	2	4	2	4	2	4	4	5	2	5	4	5
2	0	3	0	3	1	3	1	4	1	3	1	3	1	4	2	3	2	4	1	4	2	2
3	1	3	1	3	2	6	2	4	1	3	1	3	1	4	3	4	4	4	1	5	3	2
4	1	2	0	5	1	4	1	5	2	4	1	3	2	6	2	6	1	7	1	4	3	3
5	1	4	1	3	2	3	2	6	1	3	1	2	2	3	3	5	3	6	2	3	2	2
6	1	3	1	3	1	3	1	3	1	3	1	2	1	5	2	4	3	7	1	3	3	2
7	1	6	1	5	2	3	2	5	2	4	1	6	1	6	2	5	3	7	2	5	3	2
8	1	4	1	4	1	3	0	3	1	3	2	2	1	6	3	5	2	7	2	4	3	2
9	1	3	0	4	1	4	1	5	1	2	2	2	3	3	2	4	3	4	2	4	2	2
10	1	2	2	3	0	2	2	3	2	4	1	4	2	4	3	4	3	3	1	7	3	4
11	1	3	1	3	1	2	1	3	1	3	0	4	1	4	3	6	3	3	1	3	3	2
12	1	2	1	2	1	3	0	1	0	1	1	2	2	3	2	3	1	3	1	3	2	2
13	1	3	1	4	0	6	2	4	0	4	2	7	0	8	2	5	2	8	3	5	3	4
14	0	2	2	6	2	4	1	6	1	4	0	5	3	4	1	3	2	4	1	4	5	3
15	1	3	0	3	0	3	1	4	1	3	1	3	1	6	1	3	1	5	2	5	2	2
16	1	4	1	4	1	7	1	3	0	4	2	7	1	3	1	3	2	4	2	5	1	2
17	1	3	2	4	1	4	1	2	2	3	2	7	1	4	3	4	4	11	3	5	1	4
18	1	3	2	4	2	6	1	4	1	4	3	4	1	4	2	4	3	4	3	4	3	3
19	1	3	1	4	0	2	1	3	0	4	0	5	0	6	2	4	2	4	1	4	2	2
20	1	2	1	2	2	2	1	2	2	3	1	3	1	4	2	5	2	4	2	2	3	1
21	1	3	1	3	2	6	1	4	1	4	1	5	2	4	2	3	3	2	2	3	3	2
22	0	4	1	4	1	6	2	3	2	3	2	3	4	2	2	4	2	6	1	3	2	2
23	1	2	2	3	2	4	1	3	1	2	2	6	1	5	3	5	2	5	2	4	3	4
24	1	3	1	4	1	3	1	3	1	4	1	4	2	3	1	4	3	3	1	5	4	2
25	0	3	1	3	1	4	1	4	1	3	1	5	2	6	3	5	2	8	2	3	3	3
26	1	4	2	4	1	6	1	4	1	3	1	4	1	6	2	4	2	6	1	7	2	2
27	1	2	0	2	1	4	1	4	0	3	0	3	2	3	2	4	2	3	1	5	2	1
28	1	3	1	3	0	4	1	2	1	2	0	3	1	3	3	4	3	6	1	4	2	2
29	1	4	3	4	1	3	1	4	1	3	1	5	1	7	3	4	3	4	2	6	3	3
30	2	4	1	4	1	3	2	4	2	3	1	4	2	4	2	4	2	8	2	7	2	2
31	1	3	1	3	1	5	1	4	1	3	2	3	0	6	3	4	2	4	2	4	3	3
32	2	3	0	5	0	8	2	3	2	4	2	4	2	5	2	4	2	3	1	6	2	2

Arabic numerals at head of columns identify situations. The first 14 *O*s are men. The remaining 18 are women.

The *percentage of change of total resistance* that took place in *O* during the experiment was found. This change occurred in addition to the deflections due to the various situations. The difference between the resistance at the beginning of the experiment and the resistance just before the whistle stimulus was given, divided by the resistance at the beginning, gave the percentage of change during the experiment.

The rate of recovery of resistance following the peak of reaction was studied because of the significance attributed to it by *Darrow* (2).

One recorded reading for each movement was felt to be justifiable for the following reasons:

With 15 *Os*, repeated readings were taken of each of the movements separately. It was found that from 5 to 12 repetitions, varying from individual to individual, were required before the response died out. With few exceptions the response gradually disappeared. When a movement was repeated with only a few seconds' rest the response gradually disappeared.

When a period of a minute or more elapsed before each repetition, the response did not vary sufficiently to warrant taking the average of a number of readings.

Movements of the type used in this study would very rarely be repeated oftener than one a minute by normal individuals under experimental conditions.

Differences in periods of latency and deflection. The data in Table I show that with few exceptions the period of latency for each of the 10 movements is less than the period of deflection. In a few cases, eight out of a total of 320, the period of latency is the same as the period of deflection. In but two cases of the total, the period of latency is longer than that of deflection. On the other hand, four exceptions occurred out of 32 to the statement that in startle the period of latency is equal to or greater than the period of deflection.

Averages of periods of latency and deflection. Table II shows the averages for all the movements for 32 cases. The differences between the two periods are more outstanding. There is no appreciable difference between the two sexes. The average for the combined group shows a decidedly longer period of deflection for all movements than for startle.

Considering the period of latency only, movements eight and nine closely approximate the period for startle. The period of deflection for these movements is, however, considerably greater than that for startle.

The period of latency is quite consistently less variable than the period of deflection, as shown by the SDs. The period of latency is shorter and the period of deflection longer for movements than for startle.

The difference between the periods of latency and deflection was found for each of the situations. The CRs show the significance of these differences. A CR of 2.0 or more usually may be considered statistically significant. In the light of that criterion the obtained differences are not statistically significant. However, the differences are consistently in one direction throughout, which may be a distinguishing characteristic.

TABLE II. *Statistical treatment of periods of latency and periods of deflection in seconds*

	Situations										
	1	2	3	4	5	6	7	8	9	10	(11)
A	0.7 3.2	1.0 3.7	1.3 3.7	1.1 4.1	1.1 3.2	1.1 3.5	1.6 4.6	2.3 4.3	2.6 5.1	1.5 4.2	2.9 2.6
B	1.0 3.1	1.2 3.5	1.0 4.4	1.2 3.3	1.1 3.2	1.3 3.8	1.4 4.5	2.2 4.0	2.3 5.1	1.7 4.5	2.4 2.3
C	0.9 3.1	1.1 3.6	1.1 4.1	1.2 4.7	1.1 3.2	1.2 3.7	1.5 4.6	2.2 4.2	2.4 5.1	1.6 4.4	2.7 2.5
D	.4 .9	.7 .5	.7 1.4	.5 1.1	.6 .2	.7 1.7	.9 1.5	.6 .3	.7 1.9	.6 1.3	.8 .3
E	1.68 —.51	1.31 —1.08	1.28 —.95	1.36 —.81	1.33 —.62	1.19 —.73	.90 —1.18	.36 —1.36	.16 —1.21	.89 —1.24	
F	0–2 2–6	0–3 2–6	0–3 2–8	0–2 1–6	0–2 1–4	0–3 2–7	0–4 2–8	1–3 3–6	1–4 2–8	1–3 2–7	1–5 1–5
G	2.2	2.5	3.0	2.5	2.1	2.6	3.1	1.9	2.6	2.7	—.2
H	2.09	2.81	1.80	1.93	2.06	1.43	1.76	1.81	1.25	1.95	—.13

A Means of 14 men for all situations
B Means of 18 women for all situations
C Means of all *O*s as a group
D SDs of the distributions of all *O*s
E CRs of the mean differences between startle (11) and each of the movements (1–10). No sign before the figures indicates that the period of latency for startle is of longer duration. Minus sign indicates that the period of deflection for startle is of shorter duration than in each of the movements
F Range of periods of latency and deflection in sec.
G Actual difference of means between period of latency and period of deflection for each situation. Period of deflection for all movements greater than period of latency. The reverse is true of emotion
H CRs of data, following G

In the table the periods of latency immediately follow the letter. Directly below them are the periods of deflection for all situations.

All formulæ and interpretations are based on Garrett (5).

The range in seconds is of considerable interest. The period of latency varied from zero to four seconds for movements and from one to five for startle. The range of the period of deflection for the movements considered as a whole was from one to eight seconds; that of startle was from one to five seconds.

In Table II the differences between the period of latency and the period of deflection for the movements are quite significant. The chances out of 100 that the true differences are greater than zero range from 89 to 100, the period of deflection being considerably greater for all movements. In startle, however, the difference is insignificant and the period of latency slightly greater.

TABLE III. *Percentage of decrease in resistance and percentage of recovery*

	M_1		M_2		M_3		R	
Situations	Dec.	Rec.	Dec.	Rec.	Dec.	Rec.	Dec.	Rec.
1	9.1	53.6	7.6	69.7	8.5	60.7	1–21 20	24–100 76
2	11.0	54.8	9.6	54.9	10.3	54.9	2–22 20	20–80 60
3	11.3	55.5	7.9	53.7	9.8	54.7	2–28 26	16–100 84
4	12.7	59.2	11.9	49.7	12.3	55.1	4–28 24	21–85 64
5	9.8	56.6	11.8	57.5	10.3	57.1	2–20 18	22–100 78
6	11.6	56.0	10.3	65.3	11.0	60.1	3–24 21	24–100 76
7	14.8	54.3	15.3	55.2	15.0	54.7	3–48 45	21–89 68
8	14.1	59.6	12.1	57.8	13.2	58.8	2–32 30	36–87 51
9	13.5	46.1	11.9	59.5	12.8	52.0	1–31 30	24–100 76
10	17.7	55.8	18.5	55.7	18.1	55.8	2–46 44	28–88 60
(11)	22.2	29.7	25.8	27.7	23.8	28.8	5–55 50	8–51 43

M_1	Mean of men, $N=14$
M_2	Mean of women, $N=18$
M_3	Mean of men and women combined, $N=32$
R	Range in thousands of ohms
Dec.	Percentage of decrease in resistance
Rec.	Percentage of recovery of resistance

These results are not in complete agreement with *Jeffress* (7) who states that the effect of taking a deep breath or of sighing is indistinguishable from the true 'reflex' in both form and latent period and is thought to be of the same general nature.

Percentage of decrease of resistance and recovery. The method of obtaining the figures presented in Tables III and IV has been discussed above. As would be expected, the actual percentages of all the *O*s varied considerably. In regard to the averages, then, of the few cases in each group, no outstanding differences appeared which could be reasonably attributed to sex.

The percentage of decrease for movement is consistently less than for startle. Differences between the movements in percentage decrease are not great. It would be presumptuous to attempt to distinguish a movement by the amount of decrease in resistance following it. The gripping of the dynamometer showed the greatest deflection. This result is to be expected because of the degree of tension created. These data confirm those of *White* (15) who observed that resistance is decreased with tension. With the exception of one movement of one *O* (crossing of knee) all movements caused a decrease of resistance. Changes as small as 300 ohms were registered by the apparatus used.

TABLE IV. *Variability of percentages of decrease and recovery in resistance, and significance between each movement and the emotion of startle, for both decrease and recovery*

	Mean per cent of decrease and recovery		$SD_{dist.}$		CR	
Situations	Decrease	Recovery	Decrease	Recovery	Decrease	Recovery
1	8.5	60.7	4.4	20.5	1.28	1.36
2	10.3	54.9	5.4	16.1	1.09	1.32
3	9.8	54.7	6.0	17.3	1.10	1.25
4	12.3	55.1	6.1	19.1	.90	1.18
5	10.3	57.1	5.2	19.4	1.10	1.25
6	11.0	60.1	6.7	17.5	.98	1.50
7	15.0	54.7	9.9	17.5	.58	1.24
8	13.2	58.8	7.5	15.5	.79	1.56
9	12.8	52.0	5.6	19.3	.88	1.48
10	18.1	55.8	10.8	17.4	.30	1.30
(11)	23.8	28.8	12.1	11.3		

The CR's indicate the significance of the difference between the emotion of startle and each movement in percentage of decrease and recovery. The percentage of decrease was consistently greater for startle than for the movements. The percentage of recovery was consistently less for startle than for the movements.

If the averages are taken as criteria the per cent of recovery in all movements was greater than that in the case of startle. The recovery for a period of time equal to the deflection time was in most cases about twice as rapid and was more uniform for movements than for a typical emotion. On the average, then, the curve for movement is more symmetrical than that for startle. In the case of individual *Os*, however, not every movement shows a more rapid recovery of resistance than startle.

Table III shows the great variability of the 32 cases for each movement, both for the decrease in resistance and for the recovery phase.

It was considered desirable to determine the variability of the percentages of decrease and recovery in resistance for each of the situations in the experiment. The SDs of the distribution of percentages of decrease and recovery are shown in Table IV. The CRs. in the same table, show that the differences between the phenomena attending various movements and those exhibited during the experience of startle are not statistically significant for either decrease or recovery of resistance. However, for these studies, all differences are consistent enough to warrant the conclusion that 88 to 94 times in 100 the difference in each case is greater than a chance difference.

General considerations. The method of calculating the change of resistance which took place during the experiment has been presented above. Twelve men showed a decrease of resistance ranging from 1 to 21 per cent. Two men showed an increase of resistance of from 2 to 7 per cent. Fifteen women showed a decrease in resistance ranging from 3 to 43 per cent, while three showed increases of from 5 to 36 per cent.

The smallest resistance of the men for the first reading was 8,600 ohms, for the women 19,700 ohms. The greatest resistance for men and women was 40,400 and 45,600 ohms, respectively.

VI. Summary and Conclusions

1. The period of latency for voluntary movements is consistently shorter than the period of latency of a typical emotion. The differences in periods of latency are not as evident in the case of passive movement and a typical emotion.

2. The period of deflection is consistently longer in any movement than in a typical emotion.

3. The period of deflection is consistently longer than the period of latency for all movements and quite significantly so.

The reverse is true in a typical emotion, but the difference is negligible.

4. From the data at hand it would seem safe to assume that, unless an individual was greatly fatigued in general or repeated a movement in rapid succession, movements considered in this study are accompanied by a lowering of resistance.

5. The average decrease in resistance following a typical emotion is greater than that following movement. This also is true in the great majority of individual cases.

6. On the average the recovery found in this study is about twice as rapid for movements as for a typical emotion. The curve associated with a typical movement consequently gives a closer approximation to the shape of a normal frequency curve. The curve for a typical emotion is more abrupt and steep when the decrease takes place. Recovery for emotion on the other hand, is gradual and of longer duration than that for movements.

7. The writer believes that, in so far as the *O*s in this study were representative of a general college population, for movements similar to those studied, it is possible to distinguish electrodermal responses accompanied by movements from those accompanied by a typical emotion. This may be achieved by a consideration of the following characteristics, observed in relation to each other: (1) if a response has a relatively short period of latency and a correspondingly longer period of deflection than another, it is likely that a movement and not an emotion accompanied it; (2) if, together with the above, the response shows a decrease in resistance and the curve is relatively symmetrical, with the deflection two or more times as rapid as the recovery phase of equal duration, it is likely that a movement accompanied the deflection.

8. From an analytical study of over 350 photographed responses it is concluded that movements of one kind *can not* be distinguished from those of another kind.

9. Great muscular tension is not required to elicit the electrodermal response. Passive movements and minimal muscular changes and contractions were sufficient to register a decrease in resistance of from 1 to 48 per cent.

10. In differentiating a response associated with a movement from that associated with a typical emotion, the period of latency, period of deflection, decrease in resistance, recovery phase, and the general shape of the curve must all be considered.

11. The present study has considered movements relatively free from emotional feeling. This statement is substantiated by the introspections of *O*s and by the fact that *E* observed no indications of emotion. However, in the typical emotion later elicited, *e.g.*, startle, there was usually a jerk or slight movement of the body. Slight tension of some muscles inevitably occurred. Despite this fact the responses correlated with movements do have characteristics which differentiate them from responses correlated with a typical emotion.

Bibliography

1. Bayley, N. A study of fear by means of the psychogalvanic technique, *Psychol. Monog.*, 38, 1928, No. 4, 1–38.
2. Darrow, C. W. The significance of the galvanic recovery curve, *Psychol. Bull.*, 28, 1931, 678–679.
3. Davis, R. C. Factors affecting the galvanic reflex, *Arch. Psychol.*, 18, 1930, 5–64.
4. Dysinger, W. S., and Ruckmick, C. A. The emotional responses of children to the motion picture situation. N. Y., Macmillan, 1933.
5. Garrett, H. E. Statistics in psychology and education. N. Y., Longmans Green, 1932.
6. Greenwald, D. U. An apparatus for measuring the electrodermal response, *Amer. J. Psychol.*, 47, 1935, 682–685.
7. Jeffress, L. A. Galvanic phenomena of the skin, *J. Exper. Psychol.*, 11, 1928, 130–144.
8. Landis, C. The electrical phenomena of the skin, *Psychol. Bull.*, 29, 1932, 693–752.
9. Richter, C. P. Physiological factors involved in the electrical resistance of the skin, *Amer. J. Physiol.*, 88, 1929, 596–615.
10. Ruckmick, C. A. Emotions in terms of the galvanometric technique, *Brit. J. Psychol.*, 21, 1930, 149–159.
11. Ruckmick, C. A. Terminology *in re* "psychogalvanic reflex," *Psychol. Rev.*, 40, 1933, 97–98.
12. Ruckmick, C. A. A new electrode for the Hathaway galvanic reflex apparatus, *Amer. J. Psychol.*, 42, 1930, 106–107.
13. Waller, A. D. The galvanometric measurement of 'emotive physiological changes,' *Proc. Roy. Soc.*, 90B, 1917–1919, 214–217.
14. Wechsler, D. On the measurement of emotional reactions, *Arch. Psychol.*, 12, 1925, No. 76, 5–181.
15. White, M. M. Relation of bodily tension to electrical resistance, *J. Exper. Psychol.*, 13, 1930, 267–277.

Contents of numbers XI-XIX
UNIVERSITY OF IOWA STUDIES IN PSYCHOLOGY

XI. 1928 (Price, $3.50)

A Study of Fear by Means of the Psychogalvanic Technique
Nancy Bayley 1
The Application of Phi-Phenomena to Beats......Ingvald B. Hauge 39
An Experimental Critique of the Seashore Consonance Test
Delia L. Larson 49
The Mode of Vibration of the Vocal Cords.......Wolfgang Metzger 82
A Vacuum Tube Technique for the Frequency Range of Phase Effect.......Erving N. Peterson 160
Some Temporal Aspects of Sound Localization......Otis C. Trimble 172
A Note in Regard to the Extent of the Vibrato..Harold M. Williams 226

XII. 1928 (Price, $3.30)
SEASHORE COMMEMORATIVE NUMBER

Dean Seashore (Introduction)....... 1
A Complete Annotated Bibliography of the Writings of Carl Emil Seashore.......J. E. Bathurst and R. D. Sinclair 3
Ten Volumes of Iowa Studies in Psychology Reviewed
Mabel Clare Williams Kemmerer 23
A Comparative Study of the Performances of Stutterers and Normal Speakers in Mirror Tracing.........Lee Edward Travis 45
Stanford Motor Skills Unit.......Robert Holmes Seashore 51
The Sense of Direction in Mental Imagery..........Carl I. Erickson 67
The Iowa State College Reasoning Test...........Thomas F. Vance 72
Vestibular Sensitivity to Intermittent Passive Rotation of the Body.......Roland C. Travis 78
Iowa Placement Examinations—A New Departure in Mental Measurement.......George D. Stoddard 92
Seashore's Plan of Sectioning on the Basis of Ability as a Motivation Device.......H. J. Arnold 102
Successful Teaching.......Russell Warrick Tallman 106
Some Aspects to be Considered in the Organization of a First Course in Psychology.......Alvhh R. Lauer 110
The Determination of a General Factor in Research Ability of College Students.......Franklin O. Smith 119
What is the Voice Vibrato?.......Milton Metfessel 126
Seashore Measures of Musical Talent.............Hazel M. Stanton 135
Five Studies of the Music Tests..................Esther Allen Gaw 145
Correlation Between Intelligence and Musical Talent Among University Students..George Cutler Fracker and Virgie M. Howard 157
The Aesthetic Attitude in Music.......Max Schoen 162
A Measure of Art Talent.......Norman C. Meier 184
The First Vocal Vibrations in the Attack in Singing
F. A. Stevens and W. R. Miles 200

XIII. 1930 (Price, $3.25)

Disturbances in Breathing during Stuttering.....Harold R. Fossler 1
Measurement in Musical Talent for the Prediction of Success in Instrumental Music.......William S. Larson 33

Contents of numbers XI–XIX (continued)

A Study in the Seashore Motor-Rhythm Test..........J. T. Nielsen 74
A Qualitative and Quantitative Study of the Emotion of Surprise Emily Patterson 85
Pitch-Patterns and Tonal Movement in Speech......Alfred R. Root 109
An Experimental Study in Control of the Vocal Vibrato Arnold H. Wagner 160

XIV. 1931 (Price, $4.00)

Voluntary Movements of the Organs of Speech in Stutterers and Non-Stutterers..............................Bruce Blackburn 1
The Comparative Study of Affective Responses by Means of the Impressive and Expressive Methods..........Donald W. Dysinger 14
An Investigation of the Phenomena Connected with the Beating Complex..................................Ingvald B. Hauge 32
Apparent Movement in Auditory Perception.........Anna Mathiesen 74
A "Central" Explanation of Sound Localization Christian A. Ruckmick 132
Variations in the Galvanic Response.............Franklin O. Smith 142
The Psychophysics of the Vibrato....................Joseph Tiffin 153
The Relation Between the Physical Pattern and the Reproduction of Short Temporal Intervals...................Dorothy Triplett 201
Experimental Studies in the Use of the Tonoscope Harold M. Williams 266

XV. 1932 (Price, $3.75)

A Phonophotographic Analysis of the Vocal Disturbances in Stuttering ....Bryng Bryngelson 1
An Action-Current and Reflex-Time Study of Psychiatric and Neurologic Cases...........................Donald W. Dysinger 31
A Clinico-Experimental Approach to the Re-Education of the Speech of Stutterers..............................Leo B. Fagan 53
Graphic Stuttering ....Leo B. Fagan 67
A Laboratory Study of Diagnostic Indices of Bilateral Neuromuscular Organization in Stutterers and Normal Speakers Herbert H. Jasper 72
Some Common Factors in Reading and Speech Disabilities George A. Kelly 175
The Remnant Capacities of the Feebleminded...William E. McClure 202
Dysintegration of Breathing and Eye-Movements in Stutterers During Silent Reading and Reasoning...........Elwood Murray 218
Causes of Maladjustment in Children..........Herbert D. Williams 276

XVI. 1933 (Price, $1.50)

The Effect of Pain and Emotional Stimuli and Alcohol upon Pupillary Reflex Activity..............W. Ralph Griggs Bender 1
Some Neuro-Physiological Sources of Action-Current Frequencies Donald B. Lindsley 33
A Comparative Study of the Achilles and the Patellar Reflex Response Latencies as Measured by the Action-Current and the Muscle-Thickening Methods..........Clarence L. Nystrom 61

XVII. 1933 (Price, $1.75)

A Statistical Comparison of Psychophysical Methods Forrest E. Linder 1
The Rôle of the Concept in Reading Ability........Paul G. Murphy 21
The Threshold of Feeling in the Ear in Relation to Artificial Hearing Aids...................................Scott N. Reger 74
The Eye-Movements of Good Readers..............Robert Y. Walker 95

Contents of numbers XI–XIX (continued)

XVIII. 1933 (Price, $2.75)

Discrimination of Compositional Balance at the Pre-school Level Parmely Clark Daniels 1
The Sensitivity of Children of Pre-school Age to Rhythm in Graphic Form.................................Constance C. Jasper 12
An Experimental Investigation of the Sensitivity of Children to Compositional Unity....................Katherine Snow Whorley 26
A Technique for Testing Color Harmony Sensitivity in Young Children................................Eileen Jackson Williams 46
The Sensitivity of Children and Adults to Color Harmony William E. Walton 51
A Study of Creative Artistic Imagination in Children by the Constant Contact Procedure............Velma Bookhart Grippen 63
Playground Behavior Differentiating Artistic from Non-artistic Children......................................Mildred Dow 82
Variation in the Æsthetic Environment of Artistic and Non-artistic Children...............................Frances Rodgers 95
The Psychophysical Functions Differentiating Artistically Superior from Artistically Inferior Children............Carolyn Tiebout 108
The Psychophysical Capacities and Abilities of College Art Students of High and Low Standing.....Hildegarde Fried Dreps 134
An Experimental Investigation of the Basic Æsthetic Factors in Costume Design..........................Wilhelmina E. Jacobson 147

XIX. 1936 (Price, $2.50)

A Study of Conditions Affecting the Functioning of the Art Appreciation Process at the Child-Level......Mildred Dow Voss 1
Empathic Responses in Children.................William E. Walton 40
The Validity and Reliability of a Modified Form of the McAdory Art Test for Use at Lower Grade Levels......Mildred Dow Voss 68
The Measurement of Quality in Children's Paintings by the Scale Method.......................................Carolyn Tiebout 85
Artistic Ability and General Intelligence Carolyn Tiebout and Norman C. Meier 95
The Stability of Artistic Aptitude at the Child Level Aulus W. Saunders 126
Art Ability without Instruction or Environmental Background: Case Study of Loran Lockhart................Norman C. Meier 155
An Instrument for the Study of Creative Artistic Intelligence Norman C. Meier and William McCloy 164

R.W.B. JACKSON LIBRARY
3 0005 03033280 6

150.8
P974
v. 48
no. 2
Psychological monographs:
general and applied - Studies
in general psychology, v. 2,

150.8
P974
v. 48
no. 2
Psychological monographs: general
and applied - Studies in general
psychology, v. 2, edited by Christian
A. Ruckmick

PSYCHOLOGICAL MONOGRAPHS

(List of earlier monographs supplied on request.)

VOL. XXXVIII.

173. **A Study of the Purkinje Phenomenon.** LOUISE L. SLOAN. Pp. 86. $1.25. 174. **A Quantitative Study of Chromatic Adaptation.** MARY RUTH ALMACK. Pp. 118. $1.75. 175. **Experimental Analysis of the Sensori-Motor Consequences of Passive Oscillation; Rotary and Rectilinear.** ROLAND C. TRAVIS and RAYMOND DODGE. Pp. 96. $1.40. 176. **University of Iowa Studies in Psychology, No. XI.** Edited by CHRISTIAN A. RUCKMICK. Pp. 231. $3.50.

VOL. XXXIX.

177. **Cerebral Destruction in Its Relation to Maze Learning.** NORMAN CAMERON. Pp. 68. $1.00. 178. **University of Iowa Studies in Psychology, No. XII (Seashore Commemorative Volume).** Edited by WALTER R. MILES and DANIEL STARCH. Pp. 223. $3.80. 179. **Time Patterns in Prose.** HELEN GRIFFITH. Pp. 82. $1.25. 180. **An Experimental Study of Recognition and Recall in Abnormal Mental Cases.** MARGARET WYLIE. Pp. 81. $1.25.

VOL. XL.

181. **University of Iowa Studies in Psychology, No. XIII.** Edited by CHRISTIAN A. RUCKMICK. Pp. 214. $3.20. 182. **Common Annoyances: A Psychological Study of Every-day Aversions and Irritations.** HULSEY CASON. Pp. 218. $3.25. 183. **A Quantitative Study of Achromatic and Chromatic Sensitivity from Center to Periphery of the Visual Field.** HAZEL A. WENTWORTH. Pp. 189. $2.75.

VOL. XLI.

184. **Conditioned Eyelid Reactions to a Light Stimulus Based on the Reflex Wink to Sound.** ERNEST R. HILGARD. Pp. 50. $.75. 185. **The Influence of Training on Changes in Variability in Achievement.** HOMER B. REED. Pp. 59. $.75. 186. **Judging Emotions from Facial Expressions.** LEO KANNER. Pp. 91. $1.50. 187. **University of Iowa Studies in Psychology, No. XIV.** Edited by CHRISTIAN A. RUCKMICK. Pp. 327. $4.00.

VOL. XLII.

188. **Modification of the Lid-Reflex by Voluntarily Induced Sets.** HELEN PEAK. Pp. 68. $1.00. 189. **An Investigation of the Responses Made in Learning a Multiple Choice Maze.** FREDERICK H. LUMLEY. Pp. 61. $1.00. 190. **An Experimental Study of Apparent Movement.** SOGO MIBAI. Pp. 91. $1.50. 191. **An Objective Study of Concept Formation.** KENNETH L. SMOKE. Pp. 46. $.75. 192. **General and Specific Attitudes.** HADLEY CANTRIL. Pp. 109. $1.50. 193. **An Experimental Study of Pitch Recognition.** LAURENCE A. PETRAN. Pp. 124. $1.75.

VOL. XLIII.

194. **University of Iowa Studies in Psychology, No. XV.** Edited by CHRISTIAN A. RUCKMICK. Pp. 303. $3.75. 195. **A Study of a Community and Its Groups and Institutions Conceived of as Behaviors of Individuals.** RICHARD L. SCHANCK. Pp. 133. $2.00. 196. **An Experimental Investigation of Eye Movements in Learning to Spell Words.** LUTHER C. GILBERT. Pp. 81. $1.50.

VOL. XLIV.

197. **University of Kansas Studies in Psychology, No. I.** Edited by RAYMOND H. WHEELER. Pp. 300. $3.75. 198. **University of Iowa Studies in Psychology, No. XVI.** Edited by CHRISTIAN A. RUCKMICK. Pp. 86. $1.50. 199. **University of Iowa Studies in Psychology, No. XVII.** Edited by CHRISTIAN A. RUCKMICK. Pp. 121. $1.75.

VOL. XLV.

200. **University of Iowa Studies in Psychology, No. XVIII (Studies in the Psychology of Art, directed by** NORMAN C. MEIER**).** Edited by CHRISTIAN A. RUCKMICK. Pp. 188. $2.75. 201. **An Experimental Study of Factors Influencing Consonance Judgments.** EUGENE G. BUGG. Pp. 100. $1.50. 202. **Binocular and Monocular Relations in Foveal Dark Adaptation.** T. W. COOK. Pp. 86. $1.25. 203. **Brain Fields and the Learning Process.** J. A. GENGERELLI. Pp. 115. $1.50. 204. **Practice and Variability: A Study in Psychological Method.** ANNE ANASTASI. Pp. 55. $.75.

VOL. XLVI.

205. **Serial Reactions Considered as Conditioned Reactions.** WILLIAM M. LEPLEY. Pp. 56. $.75. 206. **A Classified Bibliography on Psychodietetics.** MARTIN F. FRITZ. Pp. 53. $.75. 207. **The Development of Alfred Binet's Psychology.** EDITH J. VARON. Pp. 129. $1.75. 208. **Autistic Gestures: An Experimental Study in Symbolic Movement.** MAURICE H. KROUT. Pp. 126. $1.75. 209. **The Nightmare Dream.** HULSEY CASON. Pp. 51. $.75. 210. **Studies in Psychology from Smith College. This number edited by** JAMES J. GIBSON. Pp. 98. $1.50.

VOL. XLVII.

211. **Trait-Names: A Psycho-lexical Study.** GORDON W. ALLPORT and HENRY S. ODBERT. Pp. 171. $2.50. 212. **Psychological Studies of Human Variability (Dodge Commemorative Number).** Edited by WALTER R. MILES. Pp. 415+xxxvi. $4.50.

VOL. XLVIII.

213. **Studies in the Psychology of Art, Volume II (University of Iowa Studies in Psychology, No. XIX).** Edited by NORMAN C. MEIER. Pp. 175. $2.50.

American Psychological Periodicals

American Journal of Psychology—Ithaca, N. Y.: Cornell University. Subscription $6.50. 624 pages ann. Ed. by K. M. Dallenbach, M. F. Washburn, Madison Bentley and E. G. Boring. Quarterly. General and experimental psychology. Founded 1887.

Journal of Genetic Psychology—Worcester, Mass.: Clark University Press. Subscription $14.00 per year; $7.00 per vol., 1000 pages ann. (2 vols.). Ed. by Carl Murchison. Quarterly. Child behavior, animal behavior, and comparative psychology. Founded 1891.

Psychological Review—Princeton, N. J.: Psychological Review Company. Subscription $5.50. 540 pages annually. Bi-monthly. General. Founded 1894. Edited by Herbert S. Langfeld.

Psychological Monographs—Princeton, N. J.: Psychological Review Company. Subscription $6.00 per vol. 500 pp. Founded 1895. Edited by John F. Dashiell. Published without fixed dates, each issue one or more researches.

Psychological Index discontinued after 1936—Princeton, N. J.: Psychological Review Co. Subscription $4.00. 400–500 pp. Founded 1895. Edited by W. S. Hunter and R. R. Willoughby. An annual bibliography of psychological literature.

Psychological Bulletin—Princeton, N. J.: Psychological Review Company. Subscription $6.00. 720 pages annually. Psychological literature. Monthly (10 numbers). Founded 1904. Edited by John A. McGeoch.

Archives of Psychology—Columbia University P. O., New York City. Subscription $6. 500 pp. per vol. Founded 1906. Ed. by R. S. Woodworth. Published without fixed dates, each number a single experimental study.

Journal of Abnormal and Social Psychology—Eno Hall, Princeton, N. J. Subscription $5.00. Edited by Henry T. Moore. Quarterly. 448 pages ann. Founded 1906. Abnormal and social.

Psychological Clinic—Philadelphia: Psychological Clinic Press. Subscription $3.00. 288 pages. Ed. by Lightner Witmer. Founded 1907. Without fixed dates (quarterly). Orthogenics, psychology, hygiene.

Journal of Educational Psychology—Baltimore: Warwick & York. Subscription $6.00. 720 pages. Monthly except June to August. Edited by Jack W. Dunlap, Percival M. Symonds and Harold E. Jones. Founded 1910.

Psychoanalytic Review—Washington, D. C.: 3617 10th St., N. W. Subscription $6. 500 pages annually. Psychoanalysis. Quarterly. Founded 1913. Ed. by W. A. White and S. E. Jelliffe.

Journal of Experimental Psychology—Princeton, N. J. Psychological Review Company, 900 pages annually. Experimental. Subscription $7.00. Founded 1916. Bi-monthly. Ed. by S. W. Fernberger.

Journal of Applied Psychology—Indianapolis: C. E. Pauley & Co. Subscription $6.00. 600 pages annually. Founded 1917. Bi-monthly. Edited by James P. Porter, Ohio University, Athens, Ohio.

Journal of Comparative Psychology—Baltimore: Williams & Wilkins Co. Subscription $5 per volume of 450 pages. Two volumes a year. Founded 1921. Bi-monthly. Edited by Knight Dunlap and Robert M. Yerkes.

Comparative Psychology Monographs—Baltimore: Johns Hopkins Press. Subscription $5. 400 pages per volume. Edited by Roy M. Dorcus. Published without fixed dates, each number a single research. Founded 1922.

Genetic Psychology Monographs—Worcester, Mass.: Clark University Press. Subscription $7.00 per vol., one volume per year. Ed. by Carl Murchison. Bi-monthly. Each number one complete research. Child, animal behavior, and comparative psychology. Founded 1925.

Psychological Abstracts—Eno Hall, Princeton, N. J. Edited by W. S. Hunter and R. R. Willoughby. Subscription $6.00. Monthly. 700 pages annually. Founded 1927. Abstracts of psychological literature.

Journal of General Psychology—Worcester, Mass.: Clark University Press. Subscription $14.00 per year; $7.00 per vol., 1000 pages ann. (2 vols.). Edited by Carl Murchinson. Founded 1927. Quarterly. Experimental, theoretical, clinical, and historical psychology.

Journal of Social Psychology—Worcester, Mass.: Clark University Press. Subscription $7.00. 500 pages annually. Edited by John Dewey. Carl Murchison, and international co-operating board. Quarterly. Political, racial, and differential psychology. Founded 1929.